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OF
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APRIL, 1925

Featuring

President's Address at
Annual Meeting

Structural Design of
Hydro-Electric Plant

Establishment of
"Freeman Fund"



Vol. XII

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ADDRESS AT THE ANNUAL MEETING

BY EDWIN H. ROGERS,* PRESIDENT, BOSTON SOCIETY OF CIVIL ENGINEERS

(March 25, 1925)

Some Random Notes on Transportation

AN outstanding feature of the whole of the civilized and the semi-civilized world is the desire and the necessity of the inhabitants to move from place to place to a greater or lesser extent, not only themselves but their goods and chattels and the products of their labor.

This movement has been apparent from the earliest times, and it has consistently increased in form and intensity as the enlightenment and civilization of the various tribes and nations progressed, until at the present time the problem of transportation is a science and industry in which a material percentage of the world's workers are directly interested.

For many centuries there was no call for the trained mind of the engineer to formulate transportation methods and facilities, but the developments of the past century in particular have demanded in constantly increasing ratio the efforts of the technical mind in solving the movement of goods and people.

The elements entering into transportation may be divided into two general items, — vehicles for conveyance, and means for getting these vehicles from one place to another.

Primitive man was of necessity limited to walking or carrying his own burdens on his back until he found a beast which could be domesticated sufficiently to carry him or his goods on the land and until he made a rude raft to use on the water. After a while man found that a beast under favorable conditions and locations could drag on the ground a heavier load than it could carry, and a drag or sled was evolved. Some one noticed that such a sled moved more easily when it was pulled over

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a round stick, and the wheeled vehicle resulted, — the original great mechanical aid to land transportation.

On the water, man first paddled his rude raft, but soon discovered the force of the wind, and then the sail came into being. The cumbersome raft developed into a canoe, thence into a larger and larger vessel equipped with sails until the practical limit was reached, and so the sailing vessel became the standard means of water transportation until the invention of the steam engine. The application of this machine to the propulsion of vessels caused the sailing vessel to be used less and less for the carrying of goods in quantity. Modern transportation by water is the field for the mechanical engineer and naval architect rather than the civil engineer, but in passing, mention may be made of the recent German invention which makes use of the power of the wind applied to cylinders revolved by motors, — an entirely new principle. Initial experiments indicate that this great force of nature may perhaps be employed once more in competition with steam on the ocean to some extent if subsequent experiments prove that it can be developed as an economic and practical success.

Except human effort, for century after century animal power was the sole method of moving goods or persons on the land, where, rather than on the sea or other waterways, the greatest developments in transportation have taken place in the past and are now in progress.

The smaller amount of power required to move bulky or heavy goods over still water as compared with very poor roads led to the conception of canals for inland transportation, on which a heavily loaded boat could be drawn by one or more horses or mules. Canals date from earliest history, but the first of practical commercial use were those built in France along the middle of the seventeenth century, followed by many of greater or lesser utility throughout Continental Europe. The British were a hundred years behind the French, the greatest development in Britain being in the latter years of the eighteenth and the early years of the nineteenth century, as instanced by over 2,700 miles, or over half the total eventual mileage in the British Isles, being built from 1760 to 1829.

Financial statistics of fifty of the British canals indicate that the stock of one-half of the companies owning and operating them sold well above par in the year 1824. Data as to subsequent shrinkage in value would be interesting if obtainable.

In the United States, canal building began approximately with the nineteenth century, and was particularly intense in the years 1816 to 1831, during which over 1,000 miles were constructed, or nearly one-

quarter of the total amount built to date. More than 60 per cent of this total mileage is now abandoned, and the balance, except those connecting large bodies of water, has been rendered unprofitable by improved forms of transportation. Even the New York barge canal, greatest and costliest of these inland waterways, has been a practical and financial failure since its completion.

It is hard to visualize this country as it was about a century ago, without a single mile of railroad. When we contemplate the heavy rock cuts and extensive fills on the pioneer railroads, we cannot but admire and respect the skill and courage of the engineers who laid out these roads in difficult topography with grades and curvature that with practically no revision have permitted of present-day operation as high-speed trunk lines under modern operating equipment, and we wonder at the faith of the promoters and investors who financed such expensive work without assured return. The cars on the earliest railroads were moved by horses, and after a lapse of a number of years the horse again came to be used to move passenger cars in street railroad work in cities and suburban territories.

After fifty years or more of use, the doom of the horsecar was sounded with the advent of the electric trolley car in the year 1889, which in a few years not only entirely replaced the horse in work of this sort, but was developed to such an extent in interurban work as to become a competitor of the steam railroads in numerous instances. The wide use of the trolley car logically led to the adaptation of electric motor to units for hauling trains in railroad service, but such development has been much less rapid than the general public anticipated ten or fifteen years ago. Contributing causes are added capitalization to cover the cost of conversion, lack of material economies in operation and maintenance, and substantial improvements accomplished in steam locomotive economy and performance. For these reasons, the substitution of electric for steam locomotive operation with attendant elimination of smoke and cinders has been accomplished in only a few isolated instances where the elimination of these nuisances was imperative, or where economies in operation were possible. At present less than 2,000 miles, or about $\frac{3}{4}$ of 1 per cent of the total railroad mileage, are so operated. Recent successful experiments in the adaptation of the Diesel engine to locomotive work may lead to the use of a new form of railroad tractor which will be sufficiently economical to permit operation to continue on now unprofitable branch lines, and will have sufficient power for heavier work on suburban service, where the practical freedom from smoke will be appreciated.

The next great achievement in motive power was the successful adaptation of the internal combustion engine to the propulsion of a vehicle for use on ordinary roads. This development produced far-reaching effect, much greater than anticipated in its inception little over a quarter of a century ago.

Reference is made, first, to road and pavement improvements, essential for the successful use of motor vehicles, and second, to the effect of the use of automobiles on other methods of mechanical transportation. These results have been most apparent in the United States, which contains some 87 per cent of the registered automobiles of the world.

Although bituminous materials had been previously used for road surfacing to a very limited extent, the world had been pretty well satisfied with water-bound road surfacing for ways not requiring a heavy pavement in the form of granite or wood block, brick or sheet asphalt on a concrete base. Pavements of any sort were practically all found in the more heavily traveled portion of the cities, the country roads customarily being unpaved and frequently impassable, or nearly so, at certain seasons. Excluding heavy pavements for city use, three principal types of surfacing have been developed for country highways, — the cement concrete, the bituminous macadam, either of the penetration or mixed type, and the blanket coat of bitumen and sand on an earth, gravel or macadam base.

The bituminous surfaced road was developed and utilized somewhat earlier than the cement concrete type, although both have only been used extensively during the past twelve or fifteen years. The early bituminous roads raveled, rutted or became wavy, and the early concrete roads cracked or disintegrated for various reasons, but these defects are rapidly being remedied or eliminated by use of improved materials, more scientific design of pavement and foundation, and greater care in construction. On state highway construction on rural roads, cement concrete now seems to be more popular than bituminous macadam, the latest figures obtainable showing as now existing about 9,000 miles of bituminous penetration macadam as compared with about 18,000 miles of cement concrete. Each has decided advantages under controlling conditions, but the comparative ratio of the yardage of the two types of surfacing appears to be growing greater in recent years in favor of cement concrete.

In the larger cities, about one-fourth of the pavements are of the block or brick type; one-fourth macadam or gravel, surface treated in part; the remaining 50 per cent largely of the sheet asphalt or other

bituminous types, with a small but rapidly growing yardage of cement concrete.

The total mileage of rural roads outside of incorporated cities and towns in the United States is now nearly 3,000,000 miles, of which about 65,000 miles have what may be termed a hard pavement, about 450,000 miles consist of improved roads of sand, clay, gravel or water-bound macadam, and the balance, earth roads in varying condition.

As compared with ten years ago, the mileage of hard pavement has nearly quadrupled, and that of improved surfacing of a less expensive type has doubled on these rural roads.

These data and the present relative mileage of surfaced country roads as compared with the earth roads of 17 per cent are illuminating as to the work that has been accomplished in this line in recent years, when one considers the vast number of cities now connected by the excellent highways which take the place of a few ruts in a sea of mud or dust formerly called a road. Add to this the equally important and extensive pavement programs accomplished in the cities and towns, and the change that has been wrought is indeed marvellous.

Steam railroad construction work went on at a rapid rate from its inception, and in the United States there was no year in which the mileage did not increase until the year 1916, but from 1916 to 1924 there has been no year that the railroad mileage has not decreased.

While new lines have been built, yet the mileage of lines abandoned has overbalanced the new construction, so that while in 1916 there were over 254,000 miles of line in the United States, this mileage has now been reduced to approximately 250,000 miles.

The government has established $5\frac{3}{4}$ per cent as a suitable return on railroad property investment, but while the railroads earned an average return of from 5.2 to 5.93 per cent from 1909 to 1916, yet in 1923 and 1924 the average was only about $4\frac{1}{2}$ per cent, or far under what may be considered a proper percentage.

This reduction of mileage and decrease in income has been due to various causes, such as increased wages, increased cost of equipment and supplies, but the unprofitableness of railroad operation has also been seriously accentuated by the definite establishment of the motor vehicle as an independent means of moving passengers and goods. The railroad lines in different parts of the country have been differently affected, the severest competition from the automobile and the bus apparently being in the New England and the Middle Atlantic States, where passengers comprise a large percentage of the railroad business and the hauls are short. That the railroads are coming back

to some extent is indicated by higher quotations for their securities and their increased allotments for improvements during the coming year over previous years. The railroads are awake to the changing conditions, and many are experimenting with the use of the truck as an auxiliary to their freight service and with gasoline units on branch lines.

The trolley roads, both the urban and more particularly the suburban and interurban roads, have been more seriously affected by the automobile competition and rising prices than the steam roads, as is evidenced by the abandonment of so many lines connecting the smaller towns. The mileage of trolley and interurban roads in the United States is now slightly less than 47,000 miles, showing a substantial amount of abandonment and but little new construction since 1918, when the mileage was at its maximum of 48,500 miles. The trolley roads have suffered severely by unlicensed and unauthorized jitney competition, but this situation is improving as the general public is realizing, after unsatisfactory experiences in certain cities, that irresponsible jitneys are a poor substitute for the regularly operated street car on which a passenger is carried by a financially responsible company. There is yet much to be accomplished in the way of control by public authority over the operation of independent bus lines in competition with the established public service corporations.

Many street railway companies are adopting bus service in lieu of the continued operation of cars on account of economic changes apparent in the running expenses of the units as well as in the saving in upkeep of track. One hundred and fifty-six street railway companies are now operating nearly twenty-five hundred busses, and these figures are rapidly increasing. For heavy city service, however, the trolley* car is not likely to be displaced by busses, as many more people can be carried per unit and with greater comfort. In operating busses, heavy and what might be thought excessive allowance as compared with street car practice is allowed by the companies for depreciation. The reason is that improvements and changes of design are constantly being introduced, recent innovations being the complete enclosing of double-deck busses, the use of the six-wheeled chassis, etc.

There are two great problems relating to the automobile at present, — the providing of adequate highways both urban and interurban, and the parking problem in the cities.

Progressive cities both large and small are arranging for new or improved distributing highways as is instanced by the Chicago, Detroit, Cleveland and St. Louis city plans and the extensive down-town

improvements suggested for Boston. County and state authorities are working with the cities for more adequate interurban highways. In some cases, the thought is toward great super-highways carrying many lines of vehicles and without grade crossings at intersecting streets so that continuous high speed can be maintained for a long distance, while other localities and different traffic experts advocate parallel roads carrying lesser traffic.

Counts of suburban motor traffic at identical places for several years show a particularly rapid increase in the number of motor vehicles, instances in Massachusetts indicating that the traffic on main roads outside the centres of population doubled in the past three years, but it may properly be questioned if the present ratio of increase will continue. Suburban and country traffic counts show that passenger cars now run from 80 to 95 per cent of the total traffic, the truck from 5 to 20 per cent, and the horse-drawn vehicle scarcely 1 per cent. These percentages indicate that it is reasonable to expect that the ratio of the motor trucks to passenger cars will materially increase as the use of trucks for moving of freight for short distances is extended. The horse will unquestionably always be with us, for no mechanical form of transportation has so far eliminated him. He is still exceedingly useful in various ways, and it appears that for general trucking purposes in cities within a radius of from three to four miles, horses are more economical than auto trucks.

The second problem of the cities is the parking or delivery problem. The capacity of mile after mile of city streets is reduced by two lanes of vehicles as a result of a line of cars parked or delivering goods on each side of a street. This means in many cases a street with a width of roadway sufficient for four lines of moving vehicles has its theoretical capacity cut in half by only two lines being able to go through. On most streets it is necessary for cars to stop to let off or take on passengers, and short stops for trucks may be required, but a no-parking regulation on a four-lane street will increase its capacity by a large percentage. It is easy to say that parking should be abolished in intensely busy portions of a city. In many cases it can be properly done without question, but in others careful consideration must be given to the general public and private convenience. The advantages of a free flow of through travel, perhaps for many who could as well go by some other route, must be weighed with the interference caused with the convenient conduct of business in adjoining property by discommoding customers in their efforts to reach stores or offices, and the restriction of the receipt or delivery of goods. The prevalent

all-day parking of employees' autos in a busy street should be strictly regulated.

So much for the auto and the momentous changes it has wrought. The next transportation problem may be aircraft, and if that vehicle becomes practicable for universal everyday use, its possibilities and results on present methods of transportation will require the attention and constructive genius of the great minds of mankind.

The Boston Society of Civil Engineers has but recently passed its seventy-fifth anniversary. When another such cycle shall have passed, random thoughts on transportation and its attendant features will undoubtedly take a far different form and describe achievements not yet conceived in the human brain.

When we contemplate the scientific and engineering achievements of the past century and make comparison with the thousands of pre-historic years when the brains of men remained fallow, the question is uppermost, what will the future bring? Prophecies are futile, time only will determine.

STRUCTURAL DESIGN FEATURES OF A HYDRO-ELECTRIC DEVELOPMENT

BY WILLIAM D. HENDERSON,* MEMBER, BOSTON SOCIETY OF CIVIL ENGINEERS

(Presented before the Designers Section, February 11, 1925)

THE features of structural design which are described in this paper are those of a recently completed plant near Bristol, New Hampshire, on the Pemigewasset River, built by the Utilities Power Company of Meredith, New Hampshire. It is a particularly interesting plant to structural engineers because it has a so-called "hollow dam," which involved considerably more detail of design than does the more common gravity type. Interest is enhanced by the fact that while it is built at present to develop a 50 to 55 foot head for the water wheels, it is so designed that its height may be increased 30 feet by building on top of the present structure to provide an 80-foot head.

The development as now built consists of a pond about two miles long created by an Ambursen dam, and a power house partially incorporated in the structure of the latter. The dam, including a 300-foot spillway, is 520 feet long and is about 50 feet high above the low point in the stream bed. Both dam and power house are founded on rock throughout. The plant is located, as is quite usual, at the head of a moderate rapids, and an island was made use of to isolate the tail race from the main river channel.

The mechanical equipment, including sluice gates, head gates, penstocks, water wheels, generators, governors, and switchboard, has all been selected for the ultimate development, except that the water wheels now have runners designed for the present head, which will have to be replaced with new runners when the dam is raised to develop the higher head.

There are three units in the power house, each 3,500 k.v.a. — 2,300 volt — 257 r.p.m. — 3 phase-60 cycle Westinghouse vertical generators, with direct connected exciters, driven by S. Morgan Smith water wheels, which will develop 2,500 h.p. with present runners and 4,400 h.p. when the higher head runners are installed and the dam is raised. The switch-

* With Jackson & Moreland, Consulting Engineers, Boston, Mass.

board is of Westinghouse make, with manually-operated, remote-control oil switches. The generator voltage is stepped up to 33,000 volts, for transmission of the energy, at an outdoor transformer substation located on the river bank just above the power house.

Incorporated in the dam are three 5 foot by 5 foot Coffin cast-iron sliding sluice gates with hand-operated stands. The head gates are 10 foot by 10 foot Broome caterpillar type, built of structural steel shapes and plates. They are equipped with wire-rope hoists, hand operated, but designed so that they can be fitted with motors if desired later. The penstocks are 3/8 inch plate steel 10 feet in diameter, reinforced with girth angles. They have 18-inch vent pipes located just behind the head gates.

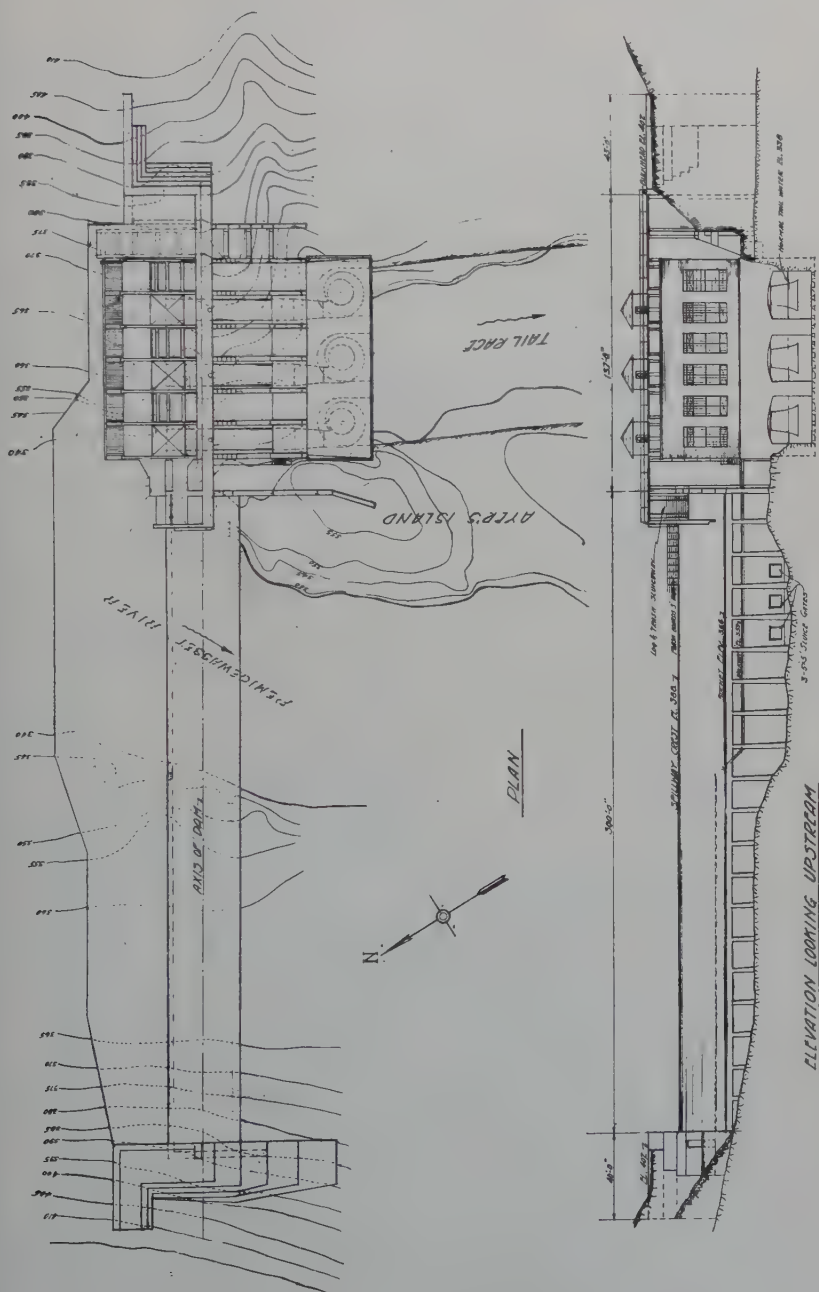
A general plan and elevation of the plant is shown on Fig. 1. Figs. 2 and 3 show a section through the intake portion of the dam and a plan of the power house. Figs. 4, 5 and 6 show sections through the bulkhead, spillway and sluice gate.

DAM

In connection with the dam, it must be borne in mind that every part, with the exception of the walkway through it, the rollway, and the walkway at the top of the intake and bulkhead section, was designed to take the loads which will be developed when the present structure is increased 30 feet in height. Furthermore, the design had to be such that future additions to gain the increased head can be practically and economically constructed.

The Ambursen dam consists of a row of concrete buttresses spaced 15 feet on centers across the river bed between the abutments. Superposed upon these buttresses are inclined reinforced concrete deck slabs which impound the water forming the pond. The angle of inclination is approximately 45 degrees with the horizontal. At the intake section of the dam the continuity of the inclined slabs is broken by horizontal and vertical slabs set in to provide for a practical arrangement of trash racks, stop-log guides, head gates, and penstock connections to the dam. In addition to the deck slabs, reinforced concrete rollway slabs are also superposed upon the buttresses in the overflow section.

The abutments are gravity type, built of plain mass concrete. They are stepped on the sides facing the earth banks, which they support and protect against erosion. They are designed to sustain the earth behind them without allowance for any support from the deck and rollway slabs. They are provided with integral reinforced haunches to carry the deck slabs which come against them, and these haunches are continued to the tops of the abutments for the continuation of the deck slabs when



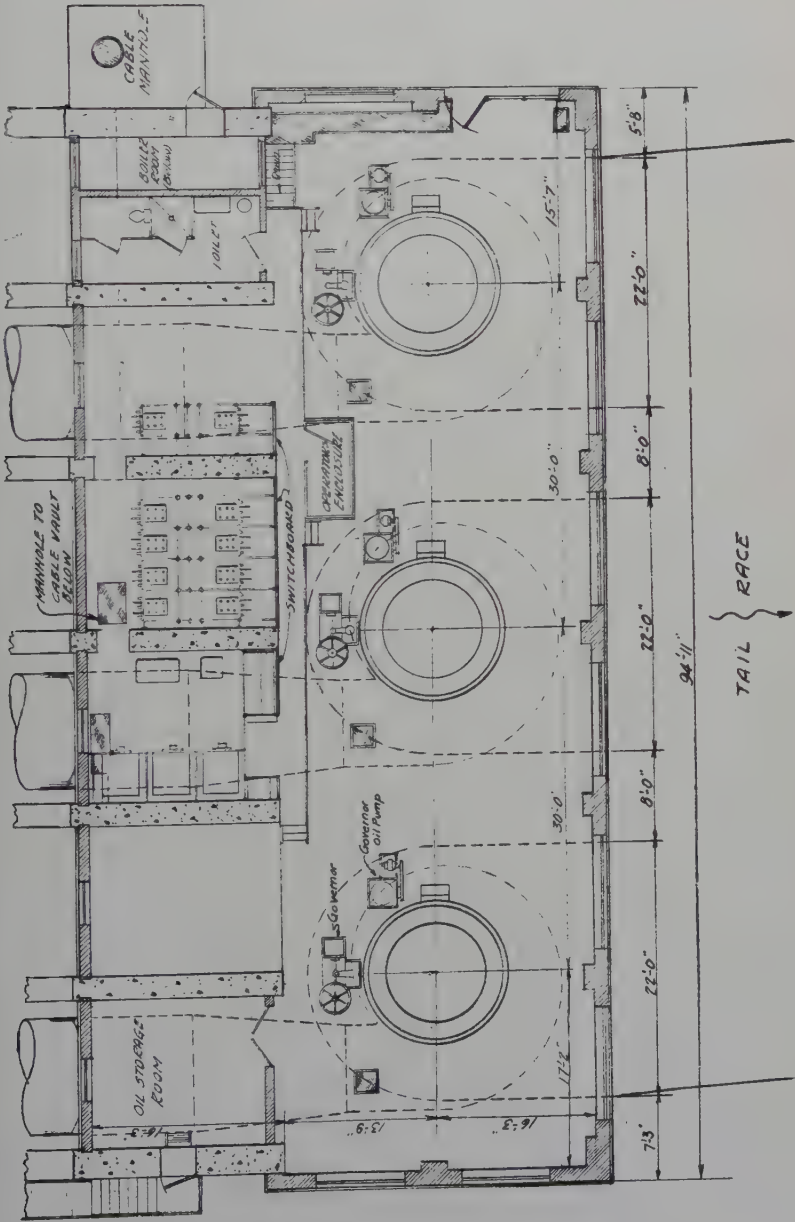


FIG. 3. — PLAN OF POWER HOUSE

the dam is raised. The upstream faces of the abutments are vertical and are carried to the same top elevation as the side faces, and cut-off walls flush with the upstream faces are carried beyond each abutment proper into the banks to prevent seepage behind the abutments.

All buttresses, except for portions of those subjected to lateral water pressure and one just east of the power house subjected to earth pressure, are substantially of plain concrete with only a few steel rods placed just above and below each construction joint. These rods are longer than the joints. The excess lengths are bent down just behind the downstream faces of the buttresses and will be uncovered and straightened out to form bond bars for the additional sections which will be added to the buttresses when the height of the dam is increased.

To provide support for the deck slabs, integral reinforced haunches set back the thickness of the deck slabs follow the upstream inclined edge face of both sides of each buttress. Of course, for the horizontal and vertical deck slabs in the intake portion of the dam these haunches are properly placed to support those slabs and the water load to which they are subjected.

At the lowest elevation above the footings the maximum standard buttress thickness is 26 inches and there is a reduction of 2 inches at the top of each 12-foot lift, that is, at each construction joint. The shoulder thus formed provided bearing support for the forms in addition to accomplishing the reduction in thickness consistent with the reduction in load-carrying requirements as the top of the dam is approached.

The buttress footings are a few inches wider than the base of the buttress, as it was not practical to cut the trenches for them in the rock river bed to the exact buttress thickness. The trenches were completely filled with concrete and were carried only to such depth as was required to reach good solid rock. The trench bottoms were stepped to general horizontal planes up and down stream. A natural declining cleavage slope upstream was not considered undesirable as a bed for footings, but generally declining slopes downstream were prohibited to obviate any question in regard to the effect upon resistance to sliding.

In the dam now built there are no struts between the buttresses under the deck slabs to mutually brace them as such struts were not considered necessary. The deck and rollway slabs are capable of giving some lateral support to the buttresses. However, when the dam is increased in height and the buttresses are extended correspondingly further downstream it is contemplated that struts between them will be needed and can be incorporated in the later construction.

The reinforced concrete deck slabs are tapered in thickness, being

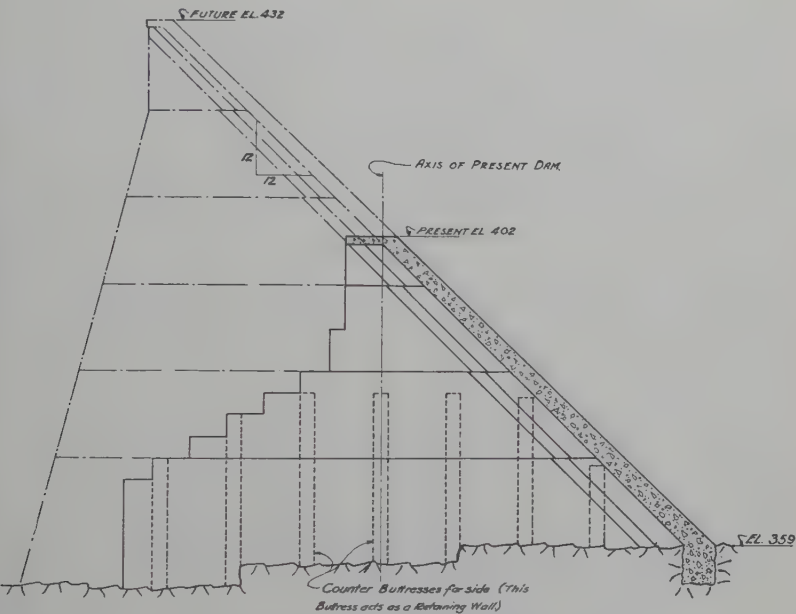


FIG. 4. — SECTION THROUGH BULKHEAD BUTTRESS
East of Power House

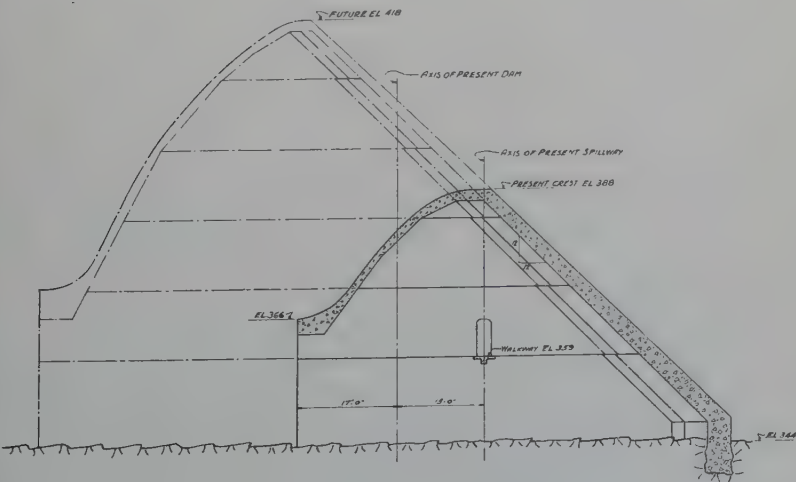


FIG. 5. — TYPICAL SECTION THROUGH SPILLWAY

greatest at the bottom where they join the cut-off wall. The latter extends 3 feet below the surface of good solid rock for the full length of the dam and is really a continuation of the deck into the rock bed. The deck slabs are designed to support the normal water pressure to which they will be subjected when the dam is 30 feet higher than at present and when the maximum estimated depth of flood water is going over the crest. The weight of the inclined slabs themselves was resolved into normal and tangential components. As the slabs span only between adjacent buttresses they were designed for simple beam action. Bent up rods were not used as it was found that the diagonal tension did not require them and straight bars are very much easier to keep in place during construction of an inclined slab. Expansion is provided for at the haunches upon which the slabs rest.

The rollway slab was similarly designed except that it was only necessary to make it capable of safely carrying the weight of flood water passing over it. It is not supported on haunches but directly upon the downstream edge faces of the buttresses. At the west abutment, and at the buttress which forms the east side wall of the spillway, the rollway slab rests in chases provided for it.

The depression in the east end of the crest of the spillway is a provision for passing trash removed from the trash racks and for passing logs in the event that lumber interests may wish to do so.

The profile of the spillway down to the bucket was designed to fit the lower nappe of the sheet of water discharged over the crest during maximum flood conditions. The equation of the curve is that of a parabola. However, the shape of the spillway was not alone relied on to prevent the formation of a vacuum behind an overflowing sheet of water. Vacuum breakers in the form of tubes passing through the spillway slab were placed in the shoulder of the convex curve. These tubes are pieces of $3\frac{1}{2}$ -inch pipe. They are slightly pitched so that thin sheets of overflow will not cause water to squirt inside of the dam. There are two such pipes in each bay between buttresses. These vacuum breakers were an inexpensive precaution. The vibration which the formation of a vacuum probably would set up could be destructive to the rollway slab.

It will be noted from the drawings and photographs that the rollway bucket, which is intended to throw the water passing the spillway away from the dam, is located rather high. This arrangement was considered satisfactory as the discharge from the bucket impinges on the rock bed some distance from the buttress footings and the rock is of a very substantial nature. Furthermore, it was desired to have as little investment in the spillway as possible, especially in view of the fact that it must be

removed when the height of the dam is increased. A timber apron was considered but estimates of comparative costs indicated that little if any saving would result from the use of timber, and the date of the ultimate development was remote enough to warrant the concrete apron.

When the later construction work is undertaken, the present apron will be removed and the downstream edges of the buttresses under it will be stepped before extending them, as are now the intake and bulkhead buttresses. A new spillway apron will then be constructed on the extension of the present buttresses.

A walkway through the dam has been provided for inspecting the inside of the spillway section and for getting across the river. Access from the west bank is had by a tunnel through the abutment. On the east end the walkway connects with a door to the power house. Except

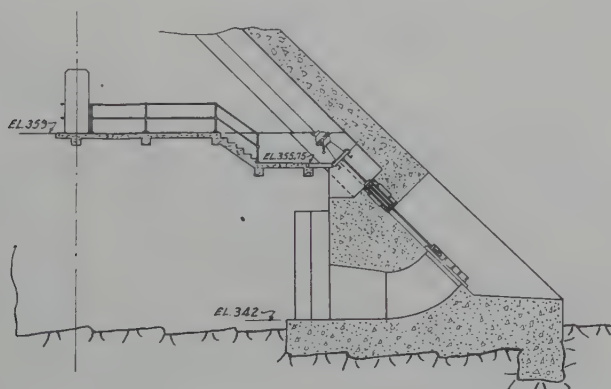


FIG. 6. — TYPICAL SECTION THROUGH SLUICE GATE

for the steel stringer and wood platform connecting the power house and the reinforced concrete stairway slab at the middle of the spillway section, the walkway is made up of reinforced concrete T-beams, precast and set and grouted in place.

The manner in which the three sluice gates are incorporated in the dam is clearly shown in Fig. 6. The orifice and expanding discharge throat are in a reinforced concrete block between the buttresses on each side of the bays in which the gates are placed. These blocks rest against vertical haunches on the buttresses and form, with the inclined deck slabs joining them at the top, the recesses in which the gates and their guides are placed. The platforms at the hoisting stands on the underside of the deck slabs are accessible from the walkway through the dam.

The intake section of the dam presented a considerable amount of

planning and design work. From Fig. 1 it will be noted that this section involves seven buttresses and horizontal shelf slabs, with vertical back slabs set in between these buttresses and a gap in the inclined deck. Triangular areas of the facing sides of the two end buttresses of the seven form the ends of the shelf, and consequently will be subjected to water

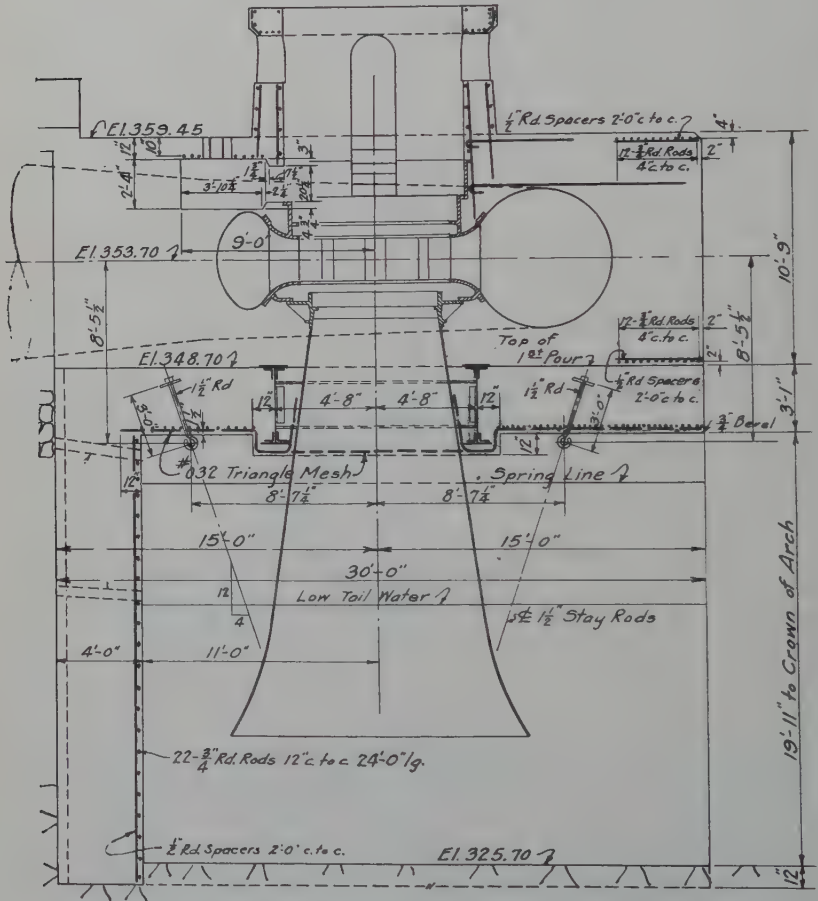


FIG. 7. — SECTION THROUGH WATER WHEEL SETTING AND GENERATOR PEDESTAL

pressure of considerable magnitude in the ultimate development, — that equivalent to a 66-foot head at the top of the horizontal slab. To take care of this pressure the thickness of the two buttresses was increased behind the wetted triangular areas and reinforcing steel was added, so

that in addition to carrying the other loads to which they were subjected they would act as vertical slabs. These two slab sections were then tied together and held in place by tension rods running across the six bays. The rods were hooked around the reinforcing bars in the end buttresses, and were placed in the horizontal deck slab and vertical back slabs and in the struts between the buttresses which are in line with the inclined deck. The rods in the horizontal slabs take the tension caused by the bending moment of the water load on the slabs and their weight, in addition to the tension developed by acting as ties as described above.

The wet portions of the intermediate five buttresses ordinarily have the water pressure on them equalized by the large rectangular openings through them. However, an unbalanced pressure will exist on that portion of any of the five intermediate buttresses which is between the stop-log grooves and the vertical and inclined deck slabs when stop-logs are in place and the space behind them is unwatered. To take care of that condition the sections of these buttresses between vertical slabs and stop-log grooves are designed to act as cantilevers having their reaction at the vertical slabs. Above the point where the vertical slabs join the inclined slabs, the portions of the buttresses which may have pressure on one side only are designed as slabs themselves. Tension rods encased in the struts between buttresses which are in other than penstock entrance bays, were designed to tie the adjacent buttresses together and prevent failure when the spaces behind stop-logs are unwatered.

In the three bays in which the penstock entrances are located the vertical slabs are much thicker than in the other three bays. They were made so to provide adequate anchorage for the upper ends of the penstocks and to minimize leakage; but thickness of concrete was not alone depended upon, as the penstocks are riveted to the head-gate frames, and the latter are well anchored in the buttresses.

Each of the three head-gate hoists is carried by two reinforced concrete beams spanning the buttresses between which they are placed. These beams are subjected to considerable load at the time the gates are lifted from their seats, and are therefore fairly heavy. Furthermore, as the hoists are wire-rope type the supporting beams for them may be subject to impact, and an allowance of 25 per cent of the load on a hoist was included in the loads for which each set of hoist-supporting beams was designed. When the hoists are relocated 30 feet higher in the ultimate development the present upstream supporting beams will have to be removed to permit extension of the gate guides and the paths for the gates when hoisted to the water surface for inspection. The other beams are designed to act later as tension struts in the manner referred to above.

At the top of the inclined deck slabs in the intake and bulkhead section, narrow horizontal slabs provide a walkway and act as ties for the tops of the buttresses. All other walkways on the intake and bulkhead section are timber supported on concrete beams.

The specifications for the dam stipulated that compression in concrete in buttresses was not to exceed 200 pounds per square inch, and in deck slabs 500 pounds. Reinforcing steel was not stressed over 16,000 pounds per square inch.

The mix for concrete used in the cut-off walls, deck and spillway slabs was in the proportions of 1 : 2 : 4, and in the abutments and buttresses 1 : 3 : 6, except for those portions of the latter which were reinforced to act as vertical slabs, where the mix was 1 : 2 : 4.



FIG. 8. — LOOKING EAST, SHOWING COMPLETED PLANT

An investigation was made of the unit pressures at the construction joints in the buttresses. It was found that at the top of the lowest footing in the spillway section of the dam, with flood water going over the crest of the ultimate development, the computed unit pressure at the toe was about 160 pounds per square inch, and at the heel about 180 pounds. These values are indicative of the low compressive unit stress in the buttresses and unit pressure on the rock supporting the dam. It will be noted that the distribution of load is fairly uniform. In these computations for unit pressures at construction joints in buttresses the horizontal plane areas were considered as rectangles and the stresses were derived as for a solid dam; however, no uplift was included, as it is considered that none would exist.

A prime consideration in the design of any dam is stability. The factors of safety with respect to resistance to overturning and to sliding must be as large as it is economically reasonable to make them. With the Ambursen dam the weight of water upon its inclined deck slab is a large factor in preventing overturning and providing resistance to sliding.

A final check for stability of this particular dam was made after the design had been completed to the point where the weights of the members could be accurately estimated. In the computations no uplift was included, for the reason already stated. In the overflow section the weight of water on the spillway apron and back-water pressure was ignored. Similarly no ice pressure with water at or below the crest level was included, as it was considered that ice will slide up the inclined deck

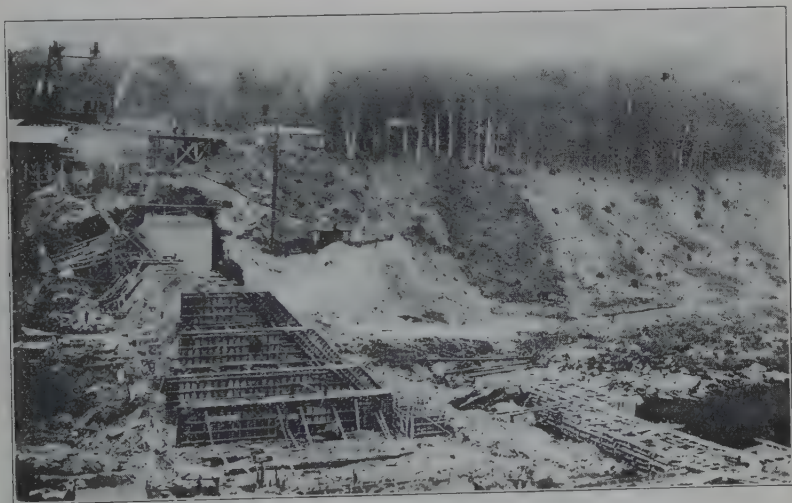


FIG. 9. — LOOKING NORTH, SHOWING EARLY STAGES OF CONSTRUCTION

and be pushed over the crest without producing an overturning thrust combined with the simultaneous horizontal component of water pressure on the dam, comparable with the overturning thrust from water pressure on the structure at flood times.

The stability computations for flood conditions on the spillway section, of both the present and future development, gave a factor of safety with respect to overturning of about 5; and for flood conditions on a bulkhead section of about $4\frac{1}{2}$.

The resistance to sliding on the rock bed of the river as represented by the coefficient of friction, for a bulkhead buttress and also for a spillway buttress, was found to be 0.6, which is considered good for concrete on rock.

It is of interest to mention the manner in which the flow of the river passed through the dam during construction. Three so-called "closure openings" were left in the three bays just west of the sluice gates, and were included in the portion of the dam built out into the stream bed behind a coffer-dam. When the latter was removed as far as the "pivot" crib and rebuilt across the rest of the river bed for the construction of the remainder of the dam, the river flow passed through these openings. They are shown in the photograph, Fig. 10. The horizontal slab a few feet above the water, supported on the projection of the buttress upstream, functioned as a temporary extension of the inclined deck slabs and provided a working platform for part of the closure operation. The buttress



FIG. 10. — LOOKING WEST, SHOWING "CLOSURE OPENINGS"

Flow of river passing through dam during construction

extensions had stop-log grooves in them flush with the edge of this slab, which extended down to a concrete base slab on the rock bed of the river below. On the inside of the dam the buttresses were provided with vertical haunches which extended from the base slab to the inclined haunches supporting the deck slabs. When the time came to make the final closure, solid timber gates were dropped into the stop-log grooves. Then forms and reinforcing bars for heavy reinforced concrete vertical slabs, which met the inclined deck slabs, were quickly built and the concrete poured from the inside of the dam. Weep pipes on the top of the base slab extended through the new concrete. These were plugged and grouted when the concrete had set sufficiently.

It will be noted from Fig. 10 that the inclined deck slabs above the closure openings had not been poured when the photograph was taken. They were left out until a month or more before the closure was made in order to have additional water passage area for floods.

Of the appurtenances to the dam two items involved structural design, — trash racks and flash boards. A feature of the trash racks is the use of fixed guide bars which form individual channels for interchangeable sections of bars. These fixed bars are flush on the raking surface with the removable bars, and act as rack bars themselves. They also accomplish a uniform bar spacing over the whole rack area, and facilitate placing and removing the removable sections.

The supporting I-beams for trash racks are 5 feet 6 inches on centers. The bars themselves were designed for a 15-foot head differential. They are often designed for the full head they would be subjected to if the spaces between them were completely clogged. However, in this case that was not considered necessary, as frazil ice and anchor ice were not anticipated.

The supporting I-beams were selected heavier than required to support racks designed for only a 15-foot head differential. This was done in order to have additional section for reduction due to corrosion, and to prevent loss of the beams themselves if unforeseen conditions cause clogging of the racks to a sufficient extent to cause the bars to fail. The excess section modulus is about five times that corresponding to the load developed on the basis on which the rack bars were designed.

In order to obtain a 55-foot head development with the least investment in the type of dam selected, it was decided to gain 5 feet of the head by the use of flash boards at such times as they could be kept in place. Flash boards as high as this are not desirable, but as it was contemplated that they would be used only in the initial development, they were adopted, although they have not yet been installed.

It is contemplated to use pipe posts for the flash boards because they are lighter and more easily handled from a scow or boat than solid soft steel or wrought-iron rods of the size that would be required, in spite of the possible greater re-use which can be obtained from the latter. It is intended to use three sizes of pipe and to divide the 300-foot crest into three sections, each 100 feet long, in which only one size of pipe posts will be placed, the intention being to have only a third of the flash boards go out at a time during a flood. As pipe posts fail with a sharp bend just above the top edge of the supporting sockets, one re-use of posts is planned by having the length great enough so that a post may be turned end for end after the first failure and still have a 5-foot straight section. Post

sockets in the dam crest are all spaced 3 feet on centers, and accordingly boards of one thickness dimension may be used between all posts without having an uneconomical excess of timber in the flash boards. In addition to post sockets, inserts for mooring pins have also been placed in the crest.

POWER HOUSE

The power house differs from the dam with regard to structural design, since no extensions or alterations are contemplated to make it fit the ultimate development. As stated, the mechanical equipment has been selected for the ultimate head. The loads which will be obtained under that head were used throughout in the design of the structural items of the power house.

The most interesting features are: the method of supporting the generating units over the tail pits, the provision made for erecting the water wheels, the station floor design which permits placing the heaviest piece of removable generating equipment practically anywhere in the generator hall (thus obviating possible injury to structure and equipment because of failure on the part of workmen to give consideration to the safe load-carrying capacity of the floor when erecting or dismantling a unit), the concrete generator pedestal which made possible a single floor station, and the design of the superstructure, particularly in respect to the use of portions of the buttresses of the dam to carry one crane rail and supports for the roof and for the upstream wall of the generator hall.

The portions of these buttresses do not function in the present dam, but will in the future, as is clearly shown by Figs. 2 and 3, which give the general arrangement of the power house, in addition to its location with respect to the present dam and the extensions which will be added in the future.

To understand fully the design of the concrete station substructure, in which the three water wheels are embedded, it is necessary to know that the latter have plate-steel scroll cases riveted to the penstocks, and plate-steel draft tubes of the common expanding taper type hung from the turbine speed rings. The use of this plate-steel work made the design of the power house substructure a very much easier problem than if concrete scrolls and draft tubes had been incorporated in it.

The scroll cases were designed by the water wheel manufacturer to withstand the bursting pressure to which they will be subjected under the ultimate head. However, it was required that they be free from any considerable external load which might be produced by the weight of concrete above them, and superposed live load on the station floor —

particularly heavy parts of dismantled generating units. To accomplish this the arch action of the concrete over the convex top surface of the scrolls was not alone relied upon. Radially placed reinforcing rods were inserted in the concrete just above the plate-steel work to give beam action which would unload to the cast-iron speed rings of the turbines at the inside, and outside of the plan area of the scrolls to the concrete below. Thus half of the total live load on the station floor and the weight of concrete above the scrolls, both within the plan area bounded by the turbine pit liners and outside the line of the scrolls, were considered as being delivered to the speed rings. For the sake of convenience this particular reaction on a speed ring will be referred to hereafter as load "W."

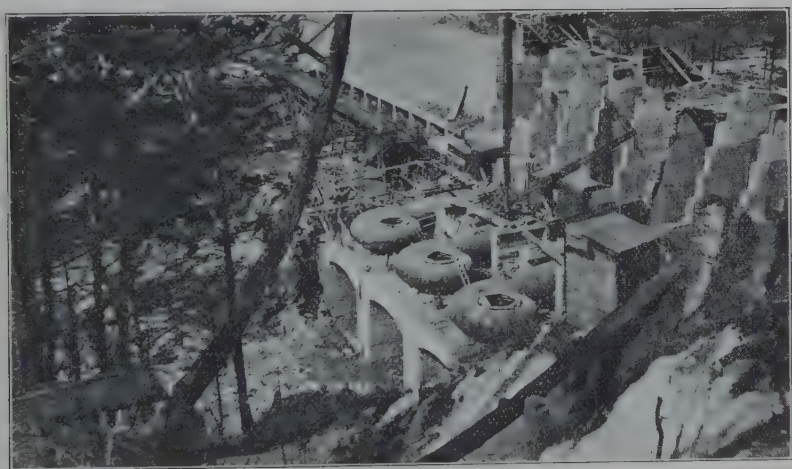


FIG. 11. — WATER WHEEL SCROLL CASES UNDER ERECTION
Downstream face of spillway shown in background

A similar treatment to that described above relieved from external load, those portions of the penstocks connecting the scrolls, which were embedded in the concrete power house substructure. Of course, here the reinforcing steel bars were placed parallel to each other and normal to the center line of the tubes.

From an inspection of Figs. 3 and 7 it will be seen that each generating unit is above a large tail pit in the station substructure. It will be noted that the dimensions of these tail pits are such that their roofs must be capable of supporting the complete generating units, the weight of concrete which surrounds the units and the live load upon the station floor which comes within the plan area of these pits.

The greatest concentration of load exists at the underside of a turbine speed ring. It was considered to be the sum of the entire weight of the generator, the revolving water wheel parts, the downward hydraulic thrust on the step bearing at the top of the generator, a vertical impact allowance of 50 per cent of the sum of the weight of the revolving element of the unit and the hydraulic thrust, the weight of the generator pedestal, the load "W" referred to, and the weight of the speed ring itself, including all attached parts excepting the plate-steel scroll case and contained water, but not excepting the draft tube. All of the load above the speed ring is transmitted to its underside through the stationary guide vanes of the cast-iron speed ring acting as columns.

To carry this concentration of load two steel plate-girders 42 inches deep, with two 26-inch Bethlehem I-beams framed between them, were placed below each speed ring and incased in the concrete roof over the tail pits, as is shown in Fig. 7. An alternate design using concrete beams was made, but the estimated cost favored the use of the structural steel.

A construction joint, which was a matter of initial design, was provided over the entire power house substructure flush with the top of the steel work just described. It is at El. 348.7 as shown in Figs. 2 and 7. When the construction work reached this grade no further concrete was poured until the speed rings had been placed, and the plate-steel work comprising the scroll cases, tapered penstock connections thereto, and draft tubes, had been erected, riveted and set exactly in place — a matter of a month's time. The construction joint provided an excellent working table for this operation as is shown in Fig. 11. The concrete between each set of steel girders and the connecting I-beams was omitted in the first pour so that the draft tubes could be assembled and riveted to the speed rings after the latter were placed.

The concrete forming the roof slab over the tail pits, in which the structural steel members were embedded, was reinforced to carry all permanent and construction loads not carried by the steel work. The construction loads were the weight of the plate-steel scroll cases and the weight of wet concrete between the construction joint and station floor. The permanent loads were considered to be the weight of the scroll cases when filled with water, the weight of concrete under them, and that portion of the concrete above them and the station floor live load not included in the load "W" previously taken care of.

There was one exception to the treatment of the roofs over the tail pits described in the preceding paragraph. It was not considered economical or practical to design the sections about four feet wide downstream of the scroll cases, adequately for the loads they will receive from the

superstructure walls and columns, including roof and crane loads on the latter. These sections were reinforced to carry only the weight of wet concrete above them, and in this latter concrete reinforcing steel was included to make what are in reality deep beams at the face of the substructure, sufficient for the permanent dead loads above the station floor grade and the maximum possible live loads.

The generator pedestals are concrete and may be considered integral with the substructure. Figs. 7 and 15 show their arrangement. They are hollow cylinders with their inside diameters the same as that of the turbine pit liners. A doorway in each, on the center line of the station and behind the steel ships-ladder leading to the generator excitors, gives

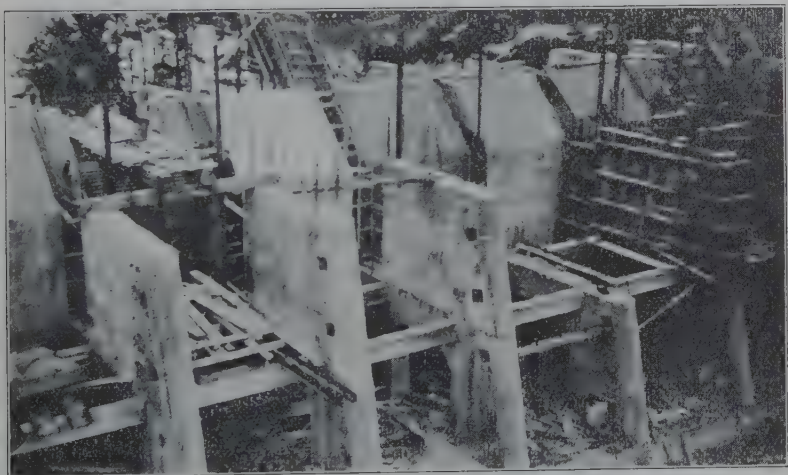


FIG. 12. — INTAKE SECTION OF DAM UNDER CONSTRUCTION

access to the interior and to the water-wheel gate mechanism which is only about three feet below the generator hall floor. In addition to the doorway there are three window-like openings which together with the doorway admit air required for generator ventilation.

The total vertical external load, applied uniformly around the top, for which each pedestal was designed was considered to be the sum of the total weight of the generator stationary parts, the weight of the revolving element of the unit including turbine runner and shaft as well as generator rotor, the hydraulic downward thrust on the step bearing at the top of the generator and an impact allowance of 50 per cent of the sum of the foregoing elements of load. In addition to the vertical load a horizontal impact allowance was assumed applied in one direction at the top of the

pedestal equivalent to 50 per cent of the total weight of the generator. It was considered that a horizontal overturning force on the pedestal of some such magnitude would represent the dynamic unbalance which might occur under certain short-circuit conditions.

Considering the pedestal as a hollow cylindrical column of the dimensions as built, but with no openings, it was found that the assumed vertical and horizontal loadings acting simultaneously produced no tension in the concrete; but because of the openings and since the pedestal is subject to vibration a liberal amount of reinforcement was used. In the top ring of concrete above the openings the reinforcement is in the form of continuous hoops, and the bending moments over the openings have been developed. Below this a grill work of steel bars was placed on the outside and inside faces of the cylinder. The vertical bars in the latter face extend down to the speed ring.

The holding-down bolts for the generators were extended down to the bottom of the pedestals. As a construction detail it was not considered practical nor necessary to have them extend into the substructure.

The superstructure of the generator hall has a concrete slab roof supported on steel rafters and purlins. The rafters are carried by steel columns on the downstream side extending to the floor, and short steel columns on the upstream side which rest upon the top of the future dam buttress extensions previously mentioned. The end purlins rest on the brick end walls of the main building.

The crane runway girders for the four-wheel 20-ton hand-operated crane, are made up of 20-inch I-beams and 8-inch channels riveted together, one flange of the channel being riveted to the web of the I-beam just below its top flange. Hook bolts are used for holding down and aligning crane rails. In designing the girders it was considered that the I-beams would take all of the vertical load and the channels all of the horizontal thrust. The latter was assumed to be one-tenth of the crane-lifting capacity per wheel. The vertical impact allowance on the crane runways was set at 25 per cent of the crane-lifting capacity. The girders are supported on concrete brackets integral with the buttresses on one side of the hall, and on the other in the usual way on the steel columns.

As is shown in Fig. 3 the spaces between the buttress extensions were made available for the switchboard, busses and switches, and for toilet and storage rooms, by reinforced concrete floor slabs supported on haunches integral with the buttresses, and a reinforced concrete roof construction similarly supported, and brick back walls. The special feature of the floor slabs is that they are reinforced top and bottom so that they will take some upward pressure in the event that an accident to the pen-

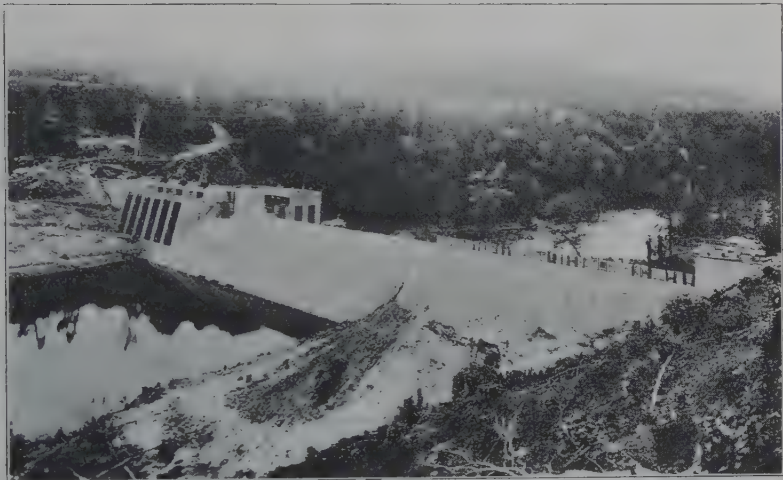


FIG. 13. — UPSTREAM FACE OF DAM
View taken just after final closure had been made



FIG. 14. — DAM AND POWER HOUSE ABOUT COMPLETED

stocks, or other reason, causes flooding of the spaces between buttresses. The capacity to take uplift is developed at the haunches on the buttresses by inverted U-shaped rods placed over the ends of the top reinforcing bars in the floor slabs, which have their bond developed in the concrete of the haunches and buttresses.

Below one of the floor slabs in the bay allotted to generator and feeder switches there is a cable vault connected by a duct bank to the cable manhole outside of the station. Below the toilet room there is a basement room which was intended for a heating boiler should steam heat in the station be desired later. The floor of the cable vault and its back wall, as well as that of the heater room, are reinforced concrete slabs



FIG. 15. — INTERIOR OF POWER HOUSE, SHOWING GENERATOR PEDESTALS

designed to resist water pressure from below and outside, respectively. The floor of the heater room rests on ledge.

The concrete in the substructure was mixed in the proportion of $1: 2\frac{1}{2}: 5$ and in all other parts, including reinforced slabs and generator pedestals, $1: 2: 4$. Great care was called for in placing concrete for the pedestals and an excellent job was obtained. The ratio of reinforcing steel to concrete in the substructure of the power house is about 20 pounds per cubic yard, and in the generator pedestals about 85 pounds per cubic yard.

The power house as a whole is a fairly common type, and much of the structural design herein described is applicable to many hydro-electric developments. On the other hand, the Ambursen dam is a proprietary

structure and cannot be considered as a common type. With the exception of the design of the abutments and the general principles involved in the determination of stability, the structural features are peculiar to the type. Of course, the design of trash racks, flash boards, and head-gate-hoist supports in the described project may be used in a development involving a common solid dam, but these items are appurtenances rather than parts of the dam *per se*.

In both the dam and power house there are many other structural phases than are covered in this paper, but all such are of a minor nature and are more or less common to all concrete work. The aim has been to present only the more important structural considerations.

OF GENERAL INTEREST

SOCIETY RECEIVES GIFT OF \$25,000

John R. Freeman Establishes Fund for Encouragement of Younger Engineers

The most important feature of the seventy-seventh annual meeting on March 25 was the announcement by President Rogers that John R. Freeman, consulting engineer of Providence, R. I., and a past president of the Society, had offered to give to the Boston Society of Civil Engineers securities having a present value of about \$25,000 and a present annual income of \$1,700, for the establishment of a fund the income of which would be devoted to the encouragement of young engineers.

In a letter to the President and the Board of Government, Mr. Freeman speaks of the inspiration and encouragement he received in his earlier years through the friendships made at the meetings of the Society. His purpose in establishing this "Freeman Fund" is to enable the Society to be of the greatest service to the younger members of the profession, and he suggests possible uses of the income as follows:

(1) By grants towards expenses for experiments, observations, and compilations towards data that will be useful in engineering and are reported to the Society.

(2) For underwriting fully or in part some of the loss that may be sustained in the publication of meritorious books, papers or translations pertaining to hydraulic science and art which might,

except for some such assistance, remain mostly inaccessible to the membership of the Society.

(3) Or such portion of the annual income as the Directors deem proper might be devoted to a yearly prize for the most useful paper relating to hydraulics contributed to this Society during the calendar year, no award being made unless a paper has been presented that is deemed worthy of special recognition, preference being given to the work of students, juniors or members under forty-five years of age.

(4) I suggest that from the income of this fund there be established once in three years a travelling scholarship, open to members under forty-five years of age, in any grade, in recognition of achievement, or promise; and for the purpose in aiding of visiting engineering works in the United States or any other part of the world where there is good prospect of obtaining information useful to engineers, report of what is found interesting to be made to this Society..

After the President's announcement of this gift, Prof. George F. Swain presented the following resolutions, which were unanimously adopted by the Society:

Whereas, The Board of Government has presented to this annual meeting resolutions which the Board has adopted respecting the generous gift to the So-

ciety by Past President John R. Freeman, with the recommendation that the Society approve them and take such action as may seem fitting; therefore be it

Resolved, That the Boston Society of Civil Engineers hereby approves the action of the Board of Government in accepting for the Society the generous gift of Mr. Freeman, and that the Society hereby expresses its recognition of the eminent place in the profession which is occupied by Mr. Freeman, its pride in his accomplishments, and its deep appreciation of the generous spirit shown by the gift and by his letter; and be it further

Resolved, That these preambles and resolutions by the Board of Government and by the Society be made a part of the records of the Society, and that an engrossed copy of each be transmitted to Mr. Freeman.

Mr. Freeman's letter and the resolutions adopted by the Board of Government in acceptance of this gift are included in the minutes of the annual meeting, printed in the Proceedings in this number of the JOURNAL.

Surprises at Annual Smoker

Do you insist on being serious? If so, don't attend the annual smoker!

Upon entering the Auditorium of the City Club to the joyful tune of Chopin's Funeral March the two hundred members and guests at the Annual Smoker donned big gaudy bow ties, in place of the time-honored paper hats, and proceeded with the important part of the program, — grub. During dinner Earl Weidner, well known organist, furnished selections on the new memorial organ of the City Club.

Following the supper, the crowd took seats in front of the stage and waited to see what sort of a show the Social Activities Committee had planned to inflict upon them this year.

When the dainty dancer, who appeared in several scenes, proved to be a regular he-man, there was the usual "old stuff — we knew *she* was a man all the time." *But the committee hadn't really started its nefarious work!*

Following a two-reel comedy film, K. C. Reynolds, chairman of the Social Activities Committee, announced a brief intermission in the entertainment program in order that the retiring president, E. H. Rogers, might introduce Angus McPherson, Chief Engineer of the Clydebank Shipbuilding Works, Glasgow, an eminent engineer who was visiting the United States. Mr. McPherson proved an excellent speaker and received a great ovation at the conclusion of his talk. At the request of Mr. L. E. Moore, who had met him in London and had learned of his familiarity with Scotch ballads, Mr. McPherson agreed to sing a verse from Annie Laurie, which he did in a most creditable manner. Unfortunately, however, as he sang another verse at the insistence of the audience, Mr. McPherson calmly removed his venerable beard, and stood revealed as John E. Daniels, well known singer of Boston. There was a gasp — then another outburst of applause; even the skeptics of the early evening had forgotten their rôle during Mr. McPherson's speech, and had accepted him as absolutely bona fide.

After another comedy reel the entertainment came to an end, and alibis flew thick and fast as the members discussed the dénouement of Mr. McPherson's act. But as every one went home with a grin, the Social Activities Committee feels that no apology is necessary.

PROCEEDINGS

MINUTES OF MEETINGS

BOSTON SOCIETY OF CIVIL ENGINEERS

MARCH 25, 1925.—The seventy-seventh annual meeting of the Boston Society of Civil Engineers was held today at the Boston City Club and was called to order by the President, Edwin H. Rogers, at 5.15 P.M.

The minutes of the previous meeting were approved as printed in the *March JOURNAL*.

The Secretary reported for the Board of Government the names of those elected to membership:

Members: Harvey C. Harris, William Noyes. *Juniors:* Charles Philip De Biasi, Nathan Ginsburg, John Augustine Howe, Joseph Elian Klam, Joseph Cornell Nowell, Jr., Charles H. Simpson, Jr.

The Secretary announced that an Affiliation meeting would probably be held either in April or May. In accordance with the recommendation of the Board it was VOTED to authorize the Board of Government to change the date of the April meeting of the Society or to omit it, if deemed advisable, on account of the Affiliation meeting.

The annual reports were then taken up. The reports of the Board of Government, Treasurer, Secretary, Committee on Library, and Committee on Social Activities were presented. The Secretary gave an informal progress report for the Committee on Subsoils of Boston.

It was VOTED that these reports be accepted and placed on file. The President announced that these would be published in the April *JOURNAL*.

It was VOTED that the incoming Board of Government be authorized to appoint such committees as it deemed advisable.

Mr. Mortimer B. A. Hooper presented the report of the Tellers of Election, and in accordance therewith the President an-

nounced that the following officers had been elected:

President — Richard K. Hale.

Vice-President (for two years) — Charles B. Breed.

Secretary — John B. Babcock, 3d.

Treasurer — Frank O. Whitney.

Directors (for two years) — Henry S. Adams, George A. Sampson.

Members of Nominating Committee (for two years) — John C. Moses, Eugene E. Pettee, Edward Wright.

Prof. Charles M. Spofford, Chairman of the Nominating Committee, then presented Gen. Richard K. Hale, the newly elected President, who spoke briefly.

Mr. E. S. Dorr, Chairman of the Committee on the Award of the Desmond Fitzgerald Medal, at the request of the President, presented the Desmond Fitzgerald Medal to Arthur C. Eaton for his paper "The New England Power Company — Davis Bridge Development," published in the January, 1925, *JOURNAL*.

The President announced that the Board of Government had awarded copies of Clemens Herschel's "Frontinus and the Water Supply of the City of Rome" to Almon L. Fales for his paper on "Odor Elimination," published in the April, 1924, *JOURNAL*, and to Charles H. Pierce for his paper on "Flood Flows of New England Rivers," published in the October, 1924, *JOURNAL*. Robert Spurr Weston made the presentation to Mr. Fales, and Prof. C. Frank Allen made the presentation to Mr. Pierce.

The President then announced that the Designers Section prize had been awarded to William D. Henderson for his paper on "Structural Design Features of a Hydro-Electric Development," presented at a meeting of the Designers Section on February 11, 1925. Mr. Rogers then pre-

sented the prize—a number of books suitably inscribed—to Mr. Henderson.

The President then read the following letter from John R. Freeman, a Past President of the Society:

MARCH 19, 1925.

To the President and Directors of the Boston Society of Civil Engineers, Tremont Temple, Boston, Mass.

GENTLEMEN:—I owe a debt to the old Boston Society of Civil Engineers, for inspiration and encouragement it gave me in my younger days through friendships and acquaintances made at the Society meetings.

It was forty-four years ago that I joined the Society. Month after month for about four years I felt well repaid by what its monthly meetings had to give, for making a sixty-mile round trip with a return after midnight. Yet today, forty years later, I have a still deeper appreciation of what the Society associations may mean to a young engineer.

I doubt if those grand men—Joseph P. Davis, Alphonse Fteley, Thomas Doane, George L. Vose and many others—realized how much encouragement their presence and friendly words gave to us youngsters. Also there were warm friendships made with members of a wonderfully fine group: Henry Manley, John Cheney, Fred Stearns, Dexter Brackett, Frank Hodgdon and many others, but few of whom now remain except Fitzgerald, Carson, Howe, Swain, Hale and myself.

It seems only fair that, when one has found lifelong happiness, and attained a competence from his profession, he should recognize the debt he owes to those who went before him and whose data he used, and should in some way try to help those young men in his profession who are following after.

In grateful recollection of these benefits I would now find pleasure in presenting to the Boston Society of Civil Engineers securities having a present value of approximately \$25,000 and a present annual income of about \$1,700.

It is my desire that the income be particularly devoted to the encouragement of young engineers in various ways, such, for example, as the following:

(1) By grants towards expenses for experiments, observations, and compilations towards data that will be useful in engineering and are reported to the Society.

(2) For underwriting fully or in part some of the loss that may be sustained in

the publication of meritorious books, papers or translations pertaining to hydraulic science and art which might, except for some such assistance, remain mostly inaccessible to the membership of the Society.

(3) Or such portion of the annual income as the Directors deem proper might be devoted to a yearly prize for the most useful paper relating to hydraulics contributed to this Society during the calendar year, no award being made unless a paper has been presented that is deemed worthy of special recognition, preference being given to the work of students, juniors or members under forty-five years of age.

(4) I suggest that from the income of this fund there be established once in three years a travelling scholarship, open to members under forty-five years of age, in any grade, in recognition of achievement, or promise; and for the purpose in aiding of visiting engineering works in the United States or any other part of the world where there is good prospect of obtaining information useful to engineers, report of what is found interesting to be made to this Society.

Since needs or calls may change from time to time, I suggest that suggestions for grants for special purposes be invited, and a flexible program followed.

I would enjoy serving for a time as one member of a committee of three or five to be appointed for the administration of this "Freeman Fund" until we can find out how to make the most use of it.

If found useful, doubtless other members will from time to time add similar funds.

In the history of the Royal Society and that of the American Association for the Advancement of Science I have been impressed with the occasional helpfulness of a small fund to a young investigator full of the zeal of youth but limited in resources for investigation.

For the above purposes I have been getting together some securities, and desiring the largest return for present purposes I have tried to safeguard this by broad distribution in the preferred stocks of twenty-five different corporations serving widely scattered communities. These largely are hydro-electric stocks.

When one or another of these is "called" for retirement I suggest reinvestment be made along similar lines.

Yours very truly,

JOHN R. FREEMAN,
Member, Boston Society of
Civil Engineers.

Mr. Rogers also presented the following resolutions which had been adopted by the Board of Government in acceptance of this gift:

Whereas, Our fellow member and Past President, John R. Freeman, has most generously offered to give 25,000 dollars to the Society, the income to be used for the encouragement and assistance of young engineers; be it

Resolved, That the Board of Government accept this gift with thanks; and be it further

Resolved, That in accepting it, the Board place on record its deep appreciation and admiration of the spirit which has prompted this act of generosity, as expressed in the splendid letter of Mr. Freeman, and its recognition and sincere admiration of his professional attainments and services, which have made that act possible; and be it further

Resolved, That these resolutions be submitted to the Society at its annual meeting with the recommendation of the Board that they be approved by such action as the Society may deem fitting.

Prof. George F. Swain then presented the following resolutions:

Whereas, The Board of Government has presented to this annual meeting resolutions which the Board has adopted respecting the generous gift to the Society by Past President John R. Freeman, with the recommendation that the Society approve them and take such action as may seem fitting; therefore be it

Resolved, That the Boston Society of Civil Engineers hereby approves the action of the Board of Government in accepting for the Society the generous gift of Mr. Freeman, and that the Society hereby expresses its recognition of the eminent place in the profession which is occupied by Mr. Freeman, its pride in his accomplishments, and its deep appreciation of the generous spirit shown by the gift and by his letter; and be it further

Resolved, That these preambles and resolutions by the Board of Government and by the Society be made a part of the records of the Society, and that an engrossed copy of each be transmitted to Mr. Freeman.

The Society VOTED unanimously to adopt these resolutions and the President and Secretary were directed to present

engrossed copies of both resolutions to Mr. Freeman.

The retiring President, Edwin H. Rogers, then delivered his annual address, "Some Random Notes on Transportation."

The business meeting thereupon adjourned and the members attended the supper and entertainment provided by the Committee on Social Activities. An account of the entertainment will appear in the news items of the April JOURNAL.

There were 195 members and guests present.

Adjourned at 9.20 P.M.

J. B. BABCOCK, *Secretary*.

SANITARY SECTION

MARCH 4, 1925. — The Annual Meeting of the Sanitary Section of the Boston Society of Civil Engineers was called to order at 7.30 P.M. in the library of the Society by the Chairman, Gordon M. Fair. Preceding the meeting, twenty-four of the members met at dinner in Marston's restaurant on Brattle Street.

The annual report of the Executive Committee was read and approved.

Prof. Dwight Porter, Chairman of the Nominating Committee, presented the following nominations for officers for the ensuing year:

Chairman — E. Sherman Chase.

Vice-Chairman — Prof. Richard G. Tyler.

Clerk — Ralph W. Horne.

Executive Committee — G. Gale Dixon, Harrison P. Eddy, Jr., N. LeRoy Hammond.

It was unanimously voted that the Clerk cast one ballot for the nominees' names.

Mr. Chase, the new Chairman, then addressed the Section for a few minutes.

Mr. F. W. Haley then read a paper illustrated by lantern slides on the Sewerage Works at Framingham, Mass., dealing especially with the pumping stations and treatment plant built in 1924. The attendance was 45.

Meeting adjourned at 9.10 P.M.

HARRISON P. EDDY, Jr., *Clerk*.

DESIGNERS SECTION

MARCH 11, 1925. — The regular March meeting of the Designers Section of the Boston Society of Civil Engineers was called to order at 6.10 P.M. in the Affiliation Rooms.

The reading of the minutes of the February meeting was omitted.

An abstract of the annual report was read.

The report of the Nominating Committee was read and accepted. It was moved that the Clerk cast one ballot electing the officers nominated. The motion was carried and the Clerk cast one ballot electing the following officers:

Chairman — J. Stuart Crandall.

Vice-Chairman — Waldo F. Pike.

Clerk — Scott Keith.

Executive Committee — W. W. Bigelow,
H. L. Bowman, H. B. Perry.

The Vice Chairman introduced Mr. Lewis E. Moore, Consulting Engineer, who spoke on "Reconstruction of the Harvard Bridge." Mr. Moore described in detail the design for the reconstruction, and illustrated his talk with lantern slides.

There were 49 members and visitors present.

The meeting adjourned at 7.30 P.M.

SCOTT KEITH, *Clerk*.

APPLICATIONS FOR MEMBERSHIP

[April 15, 1925.]

THE By-Laws provide that the Board of Government shall consider applications for membership with reference to the eligibility of each candidate for admission and shall determine the proper grade of membership to which he is entitled.

The Board must depend largely upon the members of the Society for the information which will enable it to arrive at a just conclusion. Every member is therefore urged to communicate promptly any facts in relation to the personal character or professional reputation and experience of the candidates which will assist the

Board in its consideration. Communications relating to applicants are considered by the Board as strictly confidential.

The fact that applicants give the names of certain members as reference does not necessarily mean that such members endorse the candidate.

The Board of Government will not consider applications until the expiration of twenty (20) days from the date given.

BANKS, CHARLES WILBUR, Newton Highlands, Mass. (Age 40, b. Bedford, N. Y.) Graduate of New York University, civil engineering course, with degree of B.S. From 1906-16 with the Catskill Aqueduct for City of New York (work included preliminary property, topographic and sub-surface surveys, construction of reinforced concrete aqueduct, etc.); 1916-18, on faculty of Wentworth Institute, teaching Applied Mechanics, strength of materials and testing laboratory, also military engineering as given the 101st Engineers; 1918-20, Associate Professor on faculty of Delaware State College, teaching surveying, drawing, materials and testing laboratory; 1920 to date, as head of Applied Science Department, Wentworth Institute. During summers miscellaneous engineering engagements, including surveys, estimates and city planning. Refers to J. B. Babcock, E. H. Cameron, F. H. Fay, E. H. Rogers, F. E. Winsor.

BARTLETT, HAROLD LESTER, Lynn, Mass. (Age 20, b. Lynn, Mass.) Graduate of Lynn Classical High School, now a Junior at Tufts College. Refers to Robinson Abbott, H. A. Gray, W. H. Johnson, E. R. McCarthy.

DOWNER, WILLIAM JOHN, Malden, Mass. (Age 20, b. Charlestown, Mass.) Graduate of Malden High School, scientific course, and now a student at Tufts College, civil engineering course. Refers to Robinson Abbott, E. P. Bliss, A. J. Harty, R. W. Loud, Benjamin Rubin.

HOWIE, GORDON G., Belmont, Mass. (Age 34, b. Melrose Highlands, Mass.) Graduate of Massachusetts Institute of Technology in 1913, with degree of B.S. in civil engineering. During summer of 1912 was rodman and instrumentman for the Directors of the Port of Boston; from June, 1913, to December, same year, was

draftsman with the New England Structural Company; was draftsman and assistant to superintendent at the Cambridge Gas Light Company from December, 1913, and is at present engineer and assistant to the superintendent with this company. Refers to E. H. Cameron, A. S. Coombs, M. W. Christie, J. P. Gallagher, F. P. Scully.

MAXIMON, HARRY I., Cambridge, Mass. (Age 35, b. Kiev, Russia.) Special student at Harvard Engineering School for three years. Draftsman and assistant to estimator with the Federal Iron Works, from June, 1924, to date. Refers to H. B. Alvord, G. M. Fair, L. J. Johnson, G. F. Swain, L. E. Weeks.

MC SWEENEY, EDWARD PATRICK, Dorchester, Mass. (Age 25, b. Charlestown, Mass.) From June, 1918, to October, same year, was a rodman with the New York, New Haven & Hartford Railroad, then enlisted. After discharge from army was with the Boston & Albany Railroad as time keeper in maintenance of way department from April, 1919, to October, 1920. Graduated in June, 1924 from Tufts College. During the summer of 1921 with Boston & Albany Railroad; in summer of 1922 rodman for the Boston Transit Commission; and during summer of 1923 engineering assistant in the Metropolitan Park Department. At present senior engineering assistant in the Metropolitan Park Commission. Refers to Robinson Abbott, D. A. Ambrose, W. H. Cronin, J. R. Rablin.

PENNEY, IRWIN MARCHANT, Boston, Mass. (Age 23, b. New York City.) Graduate of Rensselaer Polytechnic Institute, 1922, with degree C.E. Employed since October, 1922, by the New York, New Haven & Hartford Railroad; at present in the construction department. Refers to C. P. Foyer, N. W. Littlefield, Jr., F. P. Nickerson, A. S. Tuttle.

WANNLUND, ARTHUR L., Somerville, Mass. (Age 28, b. East Boston, Mass.) Technically trained. 1911-13, employed as apprentice at the Guy S. Leavitt Company; 1913, tracer at the National Appraisal Company; 1914, detailer at the Boston Structural Steel Company; 1914-20, draftsman at the A. L. Smith Iron

Works; 1920-22, engineer at the Progressive Iron Works; 1922-24, data engineer at the Eastern Bridge and Structural Company; 1924, detailer and checker at the A. L. Smith Iron Works, and is at present employed by this company. Refers to B. S. Brown, O. D. Chiesa, B. E. Sullivan, A. O. Wilson.

WHITEHOUSE, MAURICE FRENCH, Boston, Mass. (Age 25, b. Moultonboro, N. H.) From 1916-21 general work; 1921-25, with the New England Structural Company; completed two-year course in structural engineering in March, 1925, at Wentworth Institute; at present inspector for New England Structural Company. Refers to J. B. Babcock, Henry Brask, F. E. Leland, E. A. Varney.

NEW MEMBERS

Members

HARVEY C. HARRIS, West Danville, Vt.
WILLIAM NOYES, 509 Fairfax Hall, Cambridge, Mass.
JOHN B. WRIGHT, 74 Beech St., Keene, N. H.

Juniors

HAROLD G. GAMBLE, 40 Mallet St., Dorchester, Mass.
NATHAN GINSBURG, 183 Paris St., East Boston, Mass.
JOHN A. HOWE, 42 Brackett St., Brighton, Mass.
JOSEPH C. NOWELL, Jr., 984 Memorial Drive, Cambridge, Mass.
CHARLES H. STIMPSON, Jr., Hill Top Road, Weston, Mass.

MEMOIR

CLARENCE HENRY ROOKS *

CLARENCE HENRY ROOKS, a member of the Boston Society of Civil Engineers, died in Methuen, Mass., on December 3, 1924.

He was born in Clifton, Maine, on December 13, 1863, and was a son of John B. and Eliza (Campbell) Rooks. Mr. Rooks was educated in the public schools of

* Memoir prepared by R. H. Hale and J. R. Baldwin.

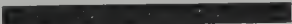
Clifton and Amherst, Maine. In 1887 he was employed by Hiram F. Mills, a former honorary member of the Boston Society of Civil Engineers, at the Lawrence Experiment Station of the Massachusetts State Board of Health. In 1888 Mr. Mills, who was the Chief Engineer of the Essex Company at Lawrence, Mass., transferred Mr. Rooks to the employ of that company where he remained to the time of his death, with the exception of a short time when he was assistant to John R. Freeman on the Charles River Dam investigation.

In 1905 he married at Lawrence, Mass., G. Edna Eastman, who survives him, together with a daughter, Frances E., born in 1907, and a son, John E., born in 1912. Mr. Rooks was a member of the Odd Fellows and Masonic fraternities, and was an attendant of the Universalist Church.

His early life as a woodsman in the forests of Maine gave him an experience

which showed the results in later life. His skill in retracing old boundary lines and his unerring instinct in finding bounds in the thickly wooded banks of the Merrimack River was always a pleasure to be noticed.

He was self-educated, but his methods of study and absorption of matters relating to hydraulic engineering were so marked that he became a very valuable man in connection with the measurement of the flow of water and the general development of water power in accordance with the present-day practice. In the management of a modern water power he was very skilful in the necessary details, and was always faithful in his work. Always courteous and pleasant to all whom he met, he leaves a vacancy which can only be filled by the memory of all who knew him.



ANNUAL REPORTS

Report of the Board of Government for the Year 1924-25

BOSTON, March 25, 1925.

To the Boston Society of Civil Engineers:

Pursuant to the requirements of the By-Laws, the Board of Government presents its report for the year ending March 25, 1925.

Membership

During the year 20 members have resigned, 37 have forfeited membership for non-payment of dues and 10 have died, making the total deductions 67.

Eighty-three members in all grades have been added during the year, of whom 4 were former members reinstated. Six juniors have been transferred to the grade of member.

The present membership of the Society consists of 7 honorary members, 791 members, 126 juniors, 24 associates, and 4 members of the Sanitary Section only, making a total membership of 952, a net gain for the year of 16.

Deaths

The loss by death during the year has been 10, as follows:

Ransom Rowe, April 1, 1924.
Arthur Bateman Corthell, May 24, 1924.
Andrew J. Gavett, May 25, 1924.
Walter Edward Parker, October 26, 1924.
George Chandler Whipple, November 27, 1924.
Clarence Henry Rooks, December 3, 1924.
Willard Kent, December 22, 1924.
Charles Hamilton Parker, January 28, 1925.
Frank P. McCarty, February 4, 1925.
John H. L. Noyes, March 20, 1925.

Remission of Dues

Under authority of By-Law 8, the Board of Government has remitted the dues of 3 members.

Exemption from Dues

Thirty-two members have been exempt from dues in accordance with the amendment to By-Law 8, which provides that "a member of any grade who has paid dues for forty years, or who has reached the age of 70 years and has paid dues for 30 years, shall be exempt from further dues."

Regular Meetings

Seven regular meetings have been held during the year, and an inspection trip to the new Weymouth Power Station of the Edison Electric Illuminating Company of Boston, and to the Airplane Carrier "U.S.S. Lexington" at the Fore River Ship Yards, which took the place of the regular meeting in June. The regular meeting in April was omitted on account of the joint meeting of the Affiliated Technical Societies of Boston and of the Associated Industries of Massachusetts on April 29, 1924, at which the principal features of the Report of the Power Investigating Committee of the Associated Industries were discussed. The November meeting was omitted on account of the meeting of the Affiliation on November 19, 1924, at which Mr. E. J. Mehren spoke on the "European Economic Outlook."

The average attendance at the meetings of the Society was 220, the largest being about 300 and the smallest 100. The average attendance this year represents an increase of about 40 per cent over last year, this being partly due to the fact that two of the meetings were held jointly with other societies, but principally because the subjects presented were also of interest to members of other societies in the Affiliation, and many of them attended our meetings.

At these meetings papers and addresses have been given, or special discussions held, as follows:

March 19, 1924. — Annual meeting. Address of the retiring President, Frank M. Gunby, "The Indictment and Suits against Cantonment Constructors"; followed by smoker and entertainment.

May 21, 1924. — Moving pictures of the "Construction of the Gilboa Dam and the Shandaken Tunnel" and "Construction of the 60,000 h.p. Caribou Hydro-electric Development in the Sierra Nevada Mountains of California," presented by Albert A. Northrop, of Stone & Webster, Inc.; and the "Casting and Driving of Reinforced Concrete Piles for the Jamaica Bay Causeway at Far Rockaway, N. Y.," a film furnished by Patrick McGovern, Inc., of New York.

September 30, 1924. — Joint meeting with the American Society for Municipal Improvements. Following a dinner at which the members of the Society were guests of the American Society for Municipal Improvements, Harvey N. Shepard gave an illustrated talk on the "Temples of South India," and Albert A. Northrop, of Stone & Webster, Inc., presented a moving picture on "Power."

October 12, 1924. — "Tropical Wharf Construction," by T. Howard Barnes, and "Marine Piling Investigations," by William F. Clapp. Col. William G. Atwood, of New York, and others, took part in the discussion which followed.

December 17, 1924. — "Davis Bridge Hydro-Electric Development of the New England Power Company," by Arthur C. Eaton, an illustrated talk followed by discussion.

January 28, 1925. — "Surveying the Grand Canyon of the Colorado" (illustrated), by Col. Claude H. Birdseye, Chief Topographic Engineer, U. S. Geological Survey.

February 28, 1925. — Joint meeting with the Northeastern Section, Am. Soc. C. E.; M. I. T. Student Chapter, Am. Soc. C. E.; Harvard Engineering Society; Tufts Civil Engineering Society and the Northeastern University Section, B. S. C. E. Robert Ridgway, President of the American Society of Civil Engineers, and Chief Engineer of the Board of Transportation of the city of New York, gave an illustrated talk on the "Rapid Transit System of New York City."

Sanitary Section Meetings

The Sanitary Section has held 5 meetings during the year, with an average attendance of 34. The following papers have been presented:

March 5, 1924. — Annual meeting. "The Control of Pollution by Oil of Public Waters in Rhode Island," by Stephen DeM. Gage, Sanitary Engineer, Rhode Island Board of Purification of Waters.

November 5, 1924. — "The Engineering and Physiological Significance of Dusts, Fumes and Smokes in Air," by Philip Drinker, Instructor in Ventilation and Illumination, Harvard School of Public Health.

December 11, 1924. — Special dinner meeting. Brief talks by members of the Committee on Sewage Disposal of the Engineering Board of Review of the Sanitary District of Chicago.

January 7, 1925. — "The Sewerage System of the Town of Westerly, R. I.," by Thomas McKenzie, Engineer and Superintendent of Water and Sewer Departments, Westerly, R. I.

February 4, 1925. — "Control of Water Purification Works of North Carolina," by H. G. Baity, Assistant Engineer, North Carolina State Board of Health.

Designers Section Meetings

The Designers Section has held 8 regular meetings during the year, with an average attendance of 83. The following papers have been presented:

March 12, 1924. — Annual meeting. "The Design of Paper Mills," by M. H. Hallenbeck, Consulting Engineer, Boston.

April 9, 1924. — "Secondary Stresses," by Harry L. Bowman, Assistant Professor of Structural Engineering, Massachusetts Institute of Technology.

May 14, 1924. — "Muscle Shoals Project with Special Emphasis on the Wilson Dam," by Maj. Stuart C. Godfrey, Engineer Officer, 1st Corps Area.

October 8, 1924. — "Boston's New Car Repair Shops at Everett," by A. J. Blackburn, Architect, Maintenance Department, Boston Elevated Railway.

November 12, 1924. — "Space Framework," by Prof. Charles M. Spofford, head of the Department of Civil and Sanitary Engineering, Massachusetts Institute of Technology.

December 10, 1924. — Discussion of 1924 Joint Committee Report on Concrete and Reinforced Concrete.

January 14, 1925. — "The Design of Structural Steel in its Relation to Detailing, Fabrication and Erection," by John C. Moses, of the Boston Bridge Works; F. S. Wells, of Densmore, LeClear & Robbins; and Frank E. Whitecross, of the Boston Building Department.

February 11, 1925. — "The Construction of the Neponset Bridge," by J. Stuart Crandall, Treasurer, Crandall Engineering Company (paper presented by R. H. Lindgren); "Structural Design Features of a Hydro-Electric Development," by William D. Henderson, civil engineer, of Jackson & Moreland (paper presented by H. B. Perry); and "The Design of Supports for Superimposed Chimneys for Power Houses," by Walter W. Clifford, of Clifford & Roebled.

Highway Section Meetings

The Highway Section was organized at an informal meeting on April 24, 1924.

Two regular meetings have been held, as follows:

May 1, 1924. — Election of officers and adoption of By-Laws.

May 28, 1924. — "Cement Concrete Road Construction," by Samuel Hobbs, of the Portland Cement Association; "Asphalt in Road Construction," by Prevost Hubbard, Chemical Engineer, Asphalt Association; and "Tar and Its Uses in Road Construction," by John S. Crandell, of the Barrett Company.

Northeastern University Section

The Northeastern University Section held two regular meetings during the year. The following papers were presented:

April 30, 1924. — Annual meeting. Election of officers, followed by a brief address by the Chairman.

January 13, 1925. — Special meeting. P. A. Shaw, Chief Engineer, with L. H. Shattuck, Inc., gave a talk on "Water Power Developments in New Hampshire."

Permanent Fund

The Society again authorized the use of the income from the Permanent Fund in payment of current expenses. Details concerning this Fund will be found in the Treasurer's report.

Journal

The report of the Editor of the JOURNAL for the calendar year 1924 shows that there have been printed ten issues, containing a total of 752 pages, the number of copies of each issue printed being 1,250. The net cost of the JOURNAL in 1924 was \$2,531.84, or \$3.37 per page. The net cost in 1923 was \$3,150.50, or \$4.61 per page.

After careful study, the Publication Committee and the Editor recommended to the Board of Government a number of changes in the form and style of the JOURNAL. These received the approval of the Board and were put into effect beginning with the January, 1925, JOURNAL. The most important change was the addition of a section "of general interest," to include short articles, current news and other matters of interest to the members. This section can only be maintained and improved by the active co-operation of the members of the Society in sending to the Editor articles and news items for publication.

Desmond FitzGerald Medal

In accordance with report of the Committee appointed to recommend the award of the Desmond FitzGerald Medal for the best paper, by a member of the Society, published during the year, the Board has awarded the medal to Arthur C. Eaton for his paper entitled "The New England Power Company — Davis Bridge Development," published in the January, 1925, JOURNAL.

Section Prizes

To encourage the preparation and presentation of papers before the several sections, particularly by the younger members, the Board voted on April 12, 1924, "to present a prize for a worthy paper given in each section by a member of that section," this award to consist of books suitably inscribed. The special committee on section award in the Designers Section has recommended that the prize this year be awarded to William D. Henderson for his paper on "Structural Design Features of a Hydro-Electric Development," presented before the Designers Section on February 11, 1925.

There were no papers presented in the other sections this year coming within the rules governing section awards.

Clemens Herschel Award

Clemens Herschel, past President and Honorary Member of the Society, has continued his gift of copies of his book on "Frontinus and the Water Supply of the City of Rome," with the request that the Board award one or more of these books each year as prizes for papers which have been particularly useful and commendable, and worthy of grateful acknowledgment.

The Board has voted to present at this time a copy of this book to Almon L. Fales for his paper on "Odor Elimination," published in the April, 1924, JOURNAL, and to Charles H. Pierce for his paper on "Flood Flows of New England Rivers," published in the October, 1924, JOURNAL.

Social Activities

During the year the Committee on Social Activities has not only served buffet suppers at the smokers held before the meetings of the Society, but has also taken charge of the buffet suppers held in connection with the Affiliation meetings in April and November, 1924. The success of the smokers is due in no small measure to the untiring efforts of the members of this committee.

Freeman Fund

The outstanding feature of the year is the splendid gift by Mr. John R. Freeman, a past President and an Honorary Member of the Society, who has offered to present to the Society securities having a present value of approximately \$25,000 and yielding an annual income of \$1,700 for the establishment of the "Freeman Fund."

In his letter announcing his intention of making this gift, Mr. Freeman speaks of the inspiration and encouragement he received from his connection with the Society, particularly in his early career, and of his desire to enable the Society to be of still greater service to the young men in their profession.

The income from this fund is to be particularly devoted to the encouragement of young engineers. Mr. Freeman has suggested several possible uses, such as the payment of expenses for experiments and compilations to be reported before the Society; underwriting meritorious books or publications pertaining to hydraulic science or art; establishment of an annual prize for a particularly valuable paper relating to hydraulics; or establishing a travelling scholarship every third year open to members of the Society for visiting engineering works, reports of which would be presented to the Society.

Upon the Society will rest the obligation and responsibility of administering this fund in such a constructive way as to justify the generosity of the donor.

Sections

The establishment of the Highway Section, and the marked activities of the other sections, have furnished convincing proof of the value to the Society of these sections. That they have not decreased the attendance at the main Society meetings is clearly shown by the 40 per cent increase in average attendance at the regular Society meetings during the past year.

Rooms and Library

Important changes have been made in the rooms and the library during the year; these have been described in the report of the Library Committee.

Relations with Other Societies

The Society has held joint meetings this year with the American Society for Municipal Improvements and with the local section of the American Society of Civil Engineers as well as with various student engineering societies.

After a careful study of the conditions, your Board has increased its financial support of the Affiliated Technical Societies of Boston, and has continued to co-operate with the Affiliation in the various activities in which it has taken part.

In conclusion, the Board wishes to express its gratitude to the officers of the sections, and to the members of the various committees and to individual members of the Society, who have rendered such valuable assistance in making this year prosperous and successful.

For the Board of Government,

EDWIN H. ROGERS, *President*.

Report of the Treasurer

BOSTON, March 1, 1925.

To the Boston Society of Civil Engineers:

Your Treasurer presents the following report for the year ending March 1, 1925.

Detailed data are contained in the appended tabular statements: Table 1 gives the receipts and expenditures for the year; Table 2, Comparative Balance Sheets; Table 3, Investment of the Permanent Fund.

The Current Expenses for the year amount to \$11,025.49, being \$271.02 increase over the preceding year.

There has been transferred to the Current Fund all the income of the Permanent Fund for the current year, \$2,579.92.

The net expense of the JOURNAL has been \$184.83 less than last year. The income from advertisements increased \$285.10, and the sale of JOURNALS has been \$26.55 less than last year.

There has been an increase in the Permanent Fund of \$600.25 after transferring the income for the current year of \$2,579.92 to the Current Fund.

Respectfully submitted,

F. O. WHITNEY, *Treasurer*.

TABLE 1. — RECEIPTS AND EXPENDITURES

CURRENT FUND

	<i>Receipts</i>	
Balance, March 1, 1924	\$53 66	
Members' dues	7,333 34	
Advertisements (net)	1,184 10	
Sale of JOURNALS	194 80	
Sale of waste paper	15 54	
Library fines	12 60	
Income from Permanent Fund	2,579 92	
Interest on deposits	10 82	
Badges (net)	13 50	
		\$11,398 28

TABLE 1. — RECEIPTS AND EXPENDITURES — *Continued*CURRENT FUND—*Concluded**Expenditures*

JOURNAL:		
Printing	\$3,217 37	
Incidentals	18 00	
Reprints	389 63	
Editor	300 00	
		\$3,925 00
Rent, meetings		125 00
Salaries (except editor)		358 50
Printing, stationery, postage, etc., meetings		352 29
Printing, stationery, postage, etc., office		290 67
Incidentals, office		171 53
Reporting, meetings		23 00
Stereopticon, meetings		84 75
Binding (net)		159 88
Insurance		33 19
Periodicals		163 20
Annual meeting and smoker (net)		151 25
Social activities (net)		393 17
Federated American Engineering Societies		189 00
Affiliated Technical Societies of Boston (net)		3,648 00
Designers Section		132 30
Sanitary Section		69 28
Highway Section		6 03
Northeastern University Section		15 80
Appropriation to Special Library Fund		200 00
Year Book		533 65
		\$11,025 49
Balance, March 1, 1925		
		\$372 79

PERMANENT FUND

Receipts

Balance, March 1, 1924	\$727 11
Entrance fees	605 00
Interest received (net)	1,910 22
Permanent investments (net)	1,466 89
	\$4,709 22

Expenditures

Co-operative banks (net)	\$1,393 30
Income transferred to Current Fund	2,579 92
	\$3,973 22
Balance, March 1, 1925	
	\$736 00

TABLE 1. — RECEIPTS AND EXPENDITURES — *Concluded*

E. K. TURNER FUND

Receipts

Balance, March 1, 1924	\$57 70
Interest on bond	50 00
	\$107 70

Expenditures

Books purchased	\$40 75
Balance, March 1, 1925	\$66 95

SPECIAL LIBRARY FUND

Receipts

Balance, March 1, 1924	\$897 70
Subscriptions and appropriation	250 00
	\$1,147 70

Expenditures

Improvement of library	\$947 70
Balance, March 1, 1925	\$200 00

TABLE 2. — COMPARATIVE BALANCE SHEETS

	March 1, 1922	March 1, 1923	March 1, 1924	March 1, 1925
<i>Assets</i>				
Cash	\$286 52	\$1,071 46	\$1,736 17	\$1,375 74
Bonds and notes	35,523 00	35,023 00	35,023 00	32,835 00
Stock	2,247 75	2,655 75	2,655 75	3,373 11
Co-operative banks	7,737 85	8,877 50	10,135 40	12,198 40
Library	7,500 00	7,500 00	7,500 00	7,500 00
Furniture	2,405 11	2,405 11	2,405 11	2,405 11
	\$55,700 23	\$57,532 82	\$59,455 43	\$59,687 36
<i>Liabilities</i>				
Permanent Fund	\$45,432 51	\$46,537 51	\$47,547 51	\$48,148 76
E. K. Turner Fund	1,083 02	1,083 24	1,051 45	1,060 70
Current Funds	720 41*	6 96	53 66	372 79
Special Library Fund	—	—	897 70	200 00
Surplus	9,905 11	9,905 11	9,905 11	9,905 11
	\$55,700 23	\$57,532 82	\$59,455 43	\$59,687 36

* Deficit.

TABLE 3. — INVESTMENT OF PERMANENT FUND, MARCH 1, 1925

	Par Value	Actual Cost	Value as carried on Books
Bonds			
American Tel. & Tel. Co., Col. Tr. 4%, 1929	\$3,000 00	\$2,328 75	\$2,737 50
Union Elec. Light & Power Co. 5%, 1932	2,000 00	2,050 00	2,050 00
Blackstone Valley Gas & Elec. Co. 5%, 1939	2,000 00	1,995 00	1,995 00
Dayton Gas Co. 5%, 1930	2,000 00	2,000 00	2,000 00
Milford & Uxbridge St. Ry. 7%, 1928	3,000 00	2,942 50	2,942 50
Railway & Light Securities Co. 5%, 1939	3,000 00	3,000 00	3,000 00
Superior Water, Light & Power Co. 4%, 1931	4,000 00	3,347 50	3,347 50
Wheeling Electric Co. 5%, 1941	4,000 00	3,845 00	3,845 00
Economy Light & Power Co. 5%, 1956	1,000 00	990 00	990 00
Tampa Electric Co. 5%, 1933	2,000 00	2,000 00	2,000 00
Galveston, Houston Elec. Ry. Co. 5%, 1954	2,000 00	1,940 00	1,940 00
Northern Texas Elec. Co. 5%, 1940	2,000 00	1,932 50	1,932 50
Chicago & Northwestern Ry. 5%, 1987	1,000 00	1,102 50	1,102 50
Vermont Power & Mfg. Co. 5%, 1928	1,000 00	965 00	965 00
Am. Tel. & Tel. Co. 5%, 1946	1,000 00	993 75	993 75
	\$33,000 00	\$31,432 50	\$31,841 25
Stock			
29 Shares Am. Tel. & Tel. Co.	2,900 00	3,373 11	3,373 11
Total securities	\$35,900 00	\$34,805 61	\$35,214 36
Co-operative Banks			
25 Shares Merchants Co-operative Bank including interest to March		\$3,878 90	
15 Shares Volunteer Co-operative Bank including interest to January		2,954 10	
30 Shares Watertown Co-operative Bank including interest to March		5,365 40	
			12,198 40
Total value of invested funds			\$47,412 76
Cash			736 00
Total value of Permanent Fund			\$48,148 76
E. K. Turner Fund			
American Tel. & Tel. Co. 5%, 1946	\$1,000 00	\$993 75	
Cash on hand	—	66 95	
			1,060 70
Total value of Permanent and E. K. Turner Funds			\$49,209 46

REPORT OF AUDITING COMMITTEE FOR YEAR 1924-25

MARCH 21, 1925.

We have examined the accounts of the Treasurer of the Boston Society of Civil Engineers and find the books correctly kept and the various expenditures of the past year supported by duly approved receipts.

The Treasurer has also accounted to us for the investments and cash on hand, as submitted by the above report.

DANA M. WOOD,
CHARLES R. MAIN,
*Auditing Committee of Directors of the
Boston Society of Civil Engineers.*

Report of the Secretary

BOSTON, March 25, 1925.

JOHN B. BABCOCK, Secretary, *in account with the* BOSTON SOCIETY OF CIVIL ENGINEERS, *Dr.*

For cash received during the year ending March 25, 1925:

From entrance fees, new members and transfers:			
36 new members and associates at	\$10 00	.	\$360 00
43 juniors at	5 00	.	215 00
6 juniors transferred to members at	5 00	.	30 00
Total from entrance fees		.	\$605 00
From annual dues for 1924-25, including dues from new members			
		.	\$7,078 34
From back dues		.	157 00
From dues for 1925-26		.	98 00
Total from dues		.	7,333 34
From advertisements		.	1,291 50
From sale of JOURNALS and reprints		.	194 80
From Library fines		.	12 60
From sale of badges		.	172 50
From binding JOURNALS		.	34 92
From sale of waste paper		.	15 54
From Social Activities Committee (smokers)		.	309 18
From contributions to Special Library Fund		.	50 00
From refund (E. K. Turner Fund)		.	2 50
			\$10,021 88

The above amount has been paid to the Treasurer, whose receipts the Secretary holds.

The appended table shows the estimated and the actual expenditures for the year.

JOHN B. BABCOCK, *Secretary.*

COMPARISON OF ESTIMATED AND ACTUAL EXPENDITURES, 1924-25

<i>Office:</i>	Estimated Expenditures	Actual Expenditures	
Salaries (except editor)	\$400 00	\$358 50	
Insurance and treasurer's bond	50 00	33 19	
Stationery, printing and postage	350 00	290 67	
Year Book	300 00	533 65	
Incidentals	150 00	171 53	
Periodicals and binding	340 00	323 08	
Total	\$1,550 00		\$1,710 62
<i>Meetings:</i>			
Rent	\$200 00	\$125 00	
Stereopticon and reporting	100 00	107 75	
Printing and postage	300 00	352 29	
Social activities (net)	350 00	393 17	
Annual meeting, 1924 (net)	150 00	151 25	
Total	1,100 00		1,129 46
<i>Journal:</i>			
Editor's salary and expenses	\$375 00	\$318 00	
Printing and postage	3,150 00	3,217 37	
Reprints	275 00	389 63	
Total	3,800 00		3,925 00
Sections	200 00	223 41	
Dues to Affiliated Technical Societies of Boston	3,648 00	3,648 00	
Dues to Federated American Engineering Societies	189 00	189 00	
	\$10,487 00		\$10,825 49
Appropriation to Special Library Fund			200 00
Total			\$11,025 49

REPORT OF AUDITING COMMITTEE FOR YEAR 1924-25

BOSTON, March 21, 1925.

We have examined the records and accounts of the Secretary of the Boston Society of Civil Engineers and have satisfied ourselves that they are properly kept, and that the money received has been transferred to the Treasurer.

DANA M. WOOD,
CHARLES R. MAIN,
*Auditing Committee of Directors of the
Boston Society of Civil Engineers.*

Report of the Editor

BOSTON, February 18, 1925.

To the Board of Government, Boston Society of Civil Engineers:

The Editor submits the following report for the calendar year 1924 (Volume XI of the JOURNAL).

There have been published eighteen papers and discussions, three reports of the activities of the American Engineering Council (formerly Federated American Engineering Societies) and nine memoirs of deceased members.

The ten issues of the JOURNAL contained a total of 752 pages; the number of copies printed was 1,250 of each issue. The net cost was \$2,531.84, or \$3.37 per page. This compares with a similar figure for 1923 of \$4.61 per page. Table 1 includes a comparison of costs for the JOURNAL from 1919 to 1924, inclusive. In Table 2 are given details of cost for Volume XI of the JOURNAL for the calendar year 1924.

After a careful study the Committee on Publication and the Editor came to the conclusion that several important changes should be made in the JOURNAL in order to increase its usefulness to the members. These changes consist of two kinds: (1) the addition of a section "of general interest" to include news items, short articles and any matters of current interest; and (2) modifications in the cover, table of contents, and general make-up, which would make the JOURNAL attractive and easier to read. The conclusions of the Committee were presented to the Board of Government for their consideration. The Board has approved these changes and they have already been put into effect in the January, 1925, number which is the beginning of Volume XII.

In order to increase the value of the JOURNAL it will be necessary to secure many articles for publication, particularly those to be included in the new section "of general interest." This will require not only constant work on the part of the Publication Committee, but also the active co-operation and support of the membership from whom this material must come to a large extent.

Respectfully submitted,

JOHN B. BABCOCK, *Editor.*

TABLE 1. — COMPARISON OF COSTS OF JOURNAL, 1919 TO 1924, INCLUSIVE

YEAR	Vol.	Number of Pages*	GROSS COST†		NET COST‡		Number of Cuts and Inserts
			Total	Per Page	Total	Per Page	
1919 . . .	VI	682	\$3,726 06	\$5 46	\$2,154 40	\$3 16	56
1920 . . .	VII	625	4,332 17	6 93	2,944 95	4 71	45
1921 . . .	VIII	674	5,088 48	7 55	3,537 91	5 25	58
1922 . . .	IX	560	4,022 14	7 18	2,960 14	5 29	76
1923 . . .	X	684	4,162 45	6 09	3,150 50	4 61	86
1924 . . .	XI	752	3,676 09	4 89	2,531 84	3 37	39

* Includes Advertising Section and Annual Index.

† Gross cost includes editing, printing, mailing and reprints.

‡ Net cost equals gross cost less amounts received for advertising, subscriptions and sale of JOURNALS and reprints.

TABLE 2. — 1924 JOURNAL, VOLUME XI

MONTH	PAGES			NUMBER		COST				
	Papers	Proceedings	Advertising	Inserts	Cuts	Composition and Printing	Inserts and Cuts	Reprints	Wrapping, Mailing and Postage	Editing* Copy-right
January	52	10	12	—	9	\$223 01	\$38 60	\$44 25		
February	32	8	12	—	—	163 20	—	—		
March	36	8	16	—	4	220 55	10 75	20 50		
April	72	32	16	—	—	390 27	—	55 50		
May	44	10	16	—	—	212 72	—	35 85		
June	46	10	16	—	7	213 39	28 45	84 50		
September	44	6	18	—	5	212 84	20 00	29 50		
October	58	6	18	—	3	373 73	12 87	45 50		
November	58	14	18	—	11	295 20	44 43	53 28		
December	26	20†	18	—	—	194 90	—	—		
Total	468	124	160†	—	39	\$2,499 81	\$155 10	\$368 88	\$327 30	\$315 00
										\$10 00

* Includes \$15 incidental expenses.

† Includes 12 pages of Annual Index.

‡ Includes advertising index and any other unpaid space.

Gross cost.

Receipts from subscriptions, sale of JOURNALS and reprints

Receipts from advertising (net)

\$3,676 09

\$180 15

964 10

1,144 25

Net cost

\$2,531 84

Report of the Library Committee, 1924-25

BOSTON, March 25, 1925.

To the Boston Society of Civil Engineers:

The Librarian submits for the Library Committee the following report for the year 1924-25.

Since the last annual report 183 bound volumes and 77 pamphlets have been added to the library. We now have about 10,400 bound volumes and 3,700 pamphlets.

During the year 330 books have been loaned and fines amounting to \$12.60 have been collected.

In the last annual report it was stated that considerable study was being given to broadening the scope of the library in order to make it more useful to our own members and to increase its service to members of the other affiliated societies. Substantial progress has been made during the year along these lines. A special library fund, totalling \$1,350, has been available, due to the generosity of a group of interested members who gave \$750, and to appropriations by the Board of Government amounting to \$600. About \$200 of this fund was spent in the year 1923-24 and \$950 during the current year, leaving a balance of \$200 to start the year 1925-26.

This fund has been used for three purposes, (1) for purchase of new books, (2) for rearrangement and more modern cataloguing, and (3) for improvement of rooms.

In connection with the purchase of books the first thing done was to bring the handbook section up to date, next, needed books on civil engineering subjects were obtained, and finally, about 40 books along electrical and mechanical lines were purchased.

During the summer the books published since 1900 were re-catalogued, using the Library of Congress system, and placed in a special alcove. This work is being actively carried forward at the present time, and the card cataloguing is being revised and improved.

Although not strictly a library activity, it was understood when the Special Library Fund was raised that a portion of it would be devoted to an improvement of the rooms and facilities. The principal work done under this head was the tearing out of some partitions and the rearrangement of office space. This has resulted in making the rooms more serviceable, both for use as a library and for availability for smokers and meetings.

Although the rooms are maintained by the Affiliation, the Society has continued to pay for periodicals and binding in addition to financing the special improvements mentioned. There has been a gratifying increase in the use of the library and reading rooms during the year, both by our own members and by members of the other affiliated societies.

The library has been kept open on Saturday afternoons, except during the summer months, and it is believed that this policy should be continued.

Your committee is convinced that the library is a valuable asset to the Society, and that each year definite improvements should be carried out in order to make it of the greatest service to our members.

Respectfully submitted,

For the Library Committee,
JOHN B. BABCOCK, *Librarian.*

BOOKS ADDED TO THE LIBRARY, 1924-25

Handbooks

Electric Railway Handbook, Richey and Greenough; Handbook of Construction Cost, Gillette; Handbook of Electrical Meterman, N.E.L.A.; Handbook of Engineering Mathematics, Wynne and Spraragen; Handbook of Fire Protection, Crosby, Fiske and Forster; Handbook of Mechanical and Electrical Cost Data, Gillette and Dana; Highway Inspectors' Handbook, Hubbard; Management's Handbook, Alford; Mechanical Engineers' Handbook, Marks; Structural Engineers' Handbook, Ketchum; Tulley's Handbook, 3 vols.

Structural

Concrete, Plain and Reinforced, Taylor and Thompson; Design of Concrete Structures, Urquhart and O'Rourke; Detailing and Fabricating Structural Steel, Dencer*; Estimating Building Costs and Appraising Buildings, Barnes; Practical Designing of Retaining Walls, Cain; Reinforced Concrete and Masonry Structures, Hool and Kinne*; Structural Engineering, 2 vols. — Strength of Materials and Fundamental Properties of Materials, Swain*; Waterproofing Engineering, Ross.

Hydraulic, Hydro-Electric and Sanitary

American Hydroelectric Practice, Taylor and Braymer; Hydraulic Flow Reviewed, Barnes; Hydraulics and Its Applications, Gibson; Marine Structures, Their Deterioration and Preservation, National Research Council; Public Water Supplies, Turneure and Russell.

Railroads and Highways

Construction of Roads and Pavements, Agg*; Electric Traction for Railway Trains, Burch; Railway Estimates, Lavis; Railway Signaling, King.

Electrical

Alternating Current Motors, McAllister; Alternating Current Phenomena, Steinmetz; American Telegraph Practice, McNicol; American Telephone Practice, Miller; Economics of Electrical Distribution, Reyneau and Seelye; Electric Power Transmission, Still; Electrical Engineering, Hazeltine*; Electrical Meters, Jansky; Electrical Phenomena in Parallel Conductors, Pernot; Interior Wiring, Cook; Light, Photometry and Illumination, Barrows; Pole and Tower Lines, Coombs; Practical Electricity, Croft; Practical Radio, Moyer and Wostrel; Principles of Direct Current Machines, Langsdorf; Principles of Transmission in Telephony, Weinbach*; Principles of Wireless Telegraphy, Pierce; Storage Battery Engineering, Lyndon; Theory and Calculation of Electric Circuits, Steinmetz.

Mechanical

Diesel Engine Design, Purday; Diesel Engines, Morrison; Engineering of Power Plants, Fernald and Orrok; Internal Combustion Engines, 2 vols., Ricardo; Mechanical Drawing for High Schools, French and Svensen; Oil Engines, Morrison.

* Gift.

Miscellaneous

Accounting and Business Methods for Contractors, Dingman*; American Fuels, 2 vols., Bacon and Hamor; Cargo Handling at Ports, Cunningham; Chronology of Iron and Steel, Goodale; Coal Manual, Wadleigh; Engineering Economics, Fish; Financial Engineering, Goldman; Gas and Fuel Analysis for Engineers, Gill; Geodesy, Hosmer*; Hendricks' Commercial Register; History and Progress of Metallurgical Science, Hadfield*; Industrial Management, Lansburgh; Modern Atlas of the World, Cram; Mosquito Eradication, Hardenburg; Principles of Iron Founding, Moldenke; Public Utilities, Hayes; Valuation of Public Service Corporations, 2 vols., Whitten; Work and Position of the Metallurgical Chemist, Hadfield*; Who's Who in America, 1924-25, Marquis.

Report of Committee on Social Activities

BOSTON, March 25, 1925.

To the Boston Society of Civil Engineers:

Your Committee on Social Activities submits the following report for the year 1924-25.

At the 7 monthly meetings during the past year the Committee has served supper to a total of 1,200 members and guests or an average of 171 per meeting. This average of 171 compares favorably with that of 140 for a year ago, and, I believe, indicates that our suppers are enjoying an increase in popularity among the members, thus insuring a good attendance at the monthly meetings. A committee, considerably larger than that of a year ago, helped serve the suppers, and the Chairman recommends a continuation of the policy of having a good-sized committee.

At the April meeting a joint meeting was held with the Affiliated Technical Societies of Boston preceded by a buffet supper in charge of the Social Activities Committee. We served about 240, or about 25 less than the largest number we ever had at a meeting with the Affiliated Societies. Another large meeting was with the Affiliated Societies in November, when we served about 200. If the reply cards for these larger meetings indicated more closely the attendance to be expected at supper, we would be able to serve our guests more promptly than at present.

In February the annual students' night occurred. We had guests from Northeastern University, Technology, Harvard and Tufts, with an attendance of about 230. Special music, furnished by an orchestra from Northeastern and by some of the Tufts men, brightened the occasion. The Chairman is glad that students' night has become an annual event.

The rain on the day set for the June outing once more caused disappointment to the Committee. An outing via boat was arranged to the Fore River Plant and to the Weymouth power station of the Edison Electric Illuminating Company. The boat trip was cancelled, but about 75 went down by train or auto and had an enjoyable trip. We hope that next year's Committee has pleasant weather for this annual function.

The program for the evening, we trust, will be an enjoyable one to the members and their guests. Mr. Lewis E. Moore and our secretary have helped considerably in their suggestions, and much credit is due them.

* Gift.

The members of the Committee have loyally helped carry on the work, and we in turn feel indebted to our secretary, John B. Babcock, for his constant help. The Chairman wishes to thank him in behalf of the Committee.

The Chairman cannot close this report without expressing his appreciation of the co-operation of the Society members in helping him carry on his work during his two years as chairman. It has been a pleasure to be of service to the Society.

Respectfully submitted,

KENNETH C. REYNOLDS, *Chairman.*

Report of Committee on Subsoils of Boston

BOSTON, March 25, 1925.

To the Boston Society of Civil Engineers:

The Committee on Boston Subsoil wishes to report progress in its work of gathering data relating to the character of the subsoil in Boston and the immediate vicinity.

Approximately 700 boring reports have been collected from various sources and examined. These reports have been transferred to cards for reference, indexed, and located upon maps. These data are available at the rooms of the Society at 715 Tremont Temple, Boston.

One of these maps, including the peninsula of Boston, has been made as a preliminary drawing. On this map is shown the outline of the original shore line of the peninsula as accurately as known, which will allow the observer at a glance to note the extent of the filling which has been necessary to permit Boston's expansion. The second map includes the Roxbury district and beyond.

The location of borings is shown by prominent white circles which represent groups and seldom single borings. Each circle on the plan may thus represent one or many borings, all of which may be seen in detail by referring to the cards.

Consideration has been given the classification of soils, but it has been thought best thus far to keep this in its simplest form and corresponding to that stated in the Boston Building Law.

The Committee has under way cross sections through the city which it is hoped will aid in a better understanding of the depth and distribution of the subsoils and rock floor. Data regarding the rock floor under Boston would be greatly appreciated by the Committee.

Regarding the matter of making borings, it is found that few borings refer to surface grades, which are in turn referenced to established city grades. This leaves many reports of doubtful value, and leads us to urge all members having borings made to insist that the people making the borings tie the surface from which the borings are made to some city grade. This may cost a little more money and take a little time but appears to be worth it.

The Committee wishes to acknowledge the hearty co-operation of the individual companies making borings and of the departments of the city in permitting and assisting us to obtain copies of borings and other data pertaining thereto.

We recommend that the work of the Committee be continued.

Respectfully submitted,

H. E. SAWTELL, *Chairman,*
for the Committee.

Report of the Executive Committee of the Sanitary Section

BOSTON, March 4, 1925.

To the Sanitary Section, Boston Society of Civil Engineers:

During the past year five meetings were held, the subjects and speakers being as follows:

March 5, 1924. — Annual meeting. "The Control of Pollution by Oil of Public Waters in Rhode Island," by Mr. Stephen DeMerritt Gage, Sanitary Engineer of the Rhode Island Board of Purification of Waters.

November 5, 1924. — "The Engineering and Physiological Significance of Dusts, Fumes and Smokes in Air," by Mr. Philip Drinker, Instructor in Ventilation and Illumination, Harvard School of Public Health.

December 11, 1924. — Special dinner meeting, with short informal talks by Messrs. H. P. Eddy, John H. Gregory, T. Chalkley Hatton, Clarence W. Hubbell, Anson Marston and Asa E. Phillips, members of the Committee on Sewage Disposal of the Engineering Board of Review of the Sanitary District of Chicago.

January 7, 1925. — "Sewerage System of the Town of Westerly," by Thomas McKenzie, Town Engineer of Westerly, R. I.

February 4, 1925. — "Control of Water Purification Works of North Carolina," by Mr. H. G. Baity, Assistant Engineer of the North Carolina State Board of Health.

Membership. — According to the records of the Secretary of the Society, the total membership of the Sanitary Section is 209, sixteen new members having joined and two members — Prof. George C. Whipple and Andrew J. Gavett — having been lost by death.

A Committee on Garbage Disposal has been appointed and has held an organization meeting. Its membership is made up of Dana M. Wood, Chairman, F. A. Marston, and Edward Wright.

Attendance. — The average attendance for the year has been 34 persons.

Respectfully submitted,

For the Executive Committee,

HARRISON P. EDDY, Jr., *Clerk.*

Report of the Executive Committee of the Designers Section

BOSTON, March 11, 1925.

To the Designers Section, Boston Society of Civil Engineers:

During the past year 8 regular meetings of the Designers Section have been held. These meetings are summarized as follows:

March 12, 1924. — *Speaker*, H. M. Hallenbeck, Consulting Engineer; *subject*, "The Design of Paper Mills;" *attendance*, 27.

April 9, 1924. — *Speaker*, Harry L. Bowman, Assistant Professor of Structural Engineering at Massachusetts Institute of Technology; *subject*, "Secondary Stresses;" *attendance*, 70.

May 14, 1924. — *Speaker*, Major Stuart C. Godfrey, Engineer Officer, First Corps Area; *subject*, "Muscle Shoals, with Particular Reference to Wilson Dam;" *attendance*, 113.

October 8, 1924. — *Speaker*, Mr. A. J. Blackburn, Architect, Maintenance Department of the Boston Elevated Railway; *subject*, "Boston's New Car Repair Shops at Everett;" *attendance*, 53.

November 12, 1924. — *Speaker*, Prof. Charles M. Spofford, Head of the Department of Civil and Sanitary Engineering at the Massachusetts Institute of Technology; *subject*, "Space Framework, including the Design of Domes and Transmission Towers;" *attendance*, 47.

December 10, 1924. — Prof. Hale Sutherland, of Massachusetts Institute of Technology, in charge of the meeting. *General subject*, The 1924 Joint Committee Report on Concrete. The report was divided into six parts, with speakers and subjects as follows: Prof. Dean Peabody, of Massachusetts Institute of Technology, "The Mixing and Proportioning of Concrete;" Charles E. Nichols, of Stone & Webster, Inc., "Design of Slabs, Beams and Columns;" Prof. Hale Sutherland, of Massachusetts Institute of Technology, "Shear and Diagonal Tension;" Walter W. Clifford, of Clifford & Roeblad, "Bond Stresses and Anchorage;" Mark Linenthal, Consulting Engineer, "Flat Slabs;" B. A. Rich, of Rich, Bigelow & Tirrell, "Column Footings and Retaining Walls;" *attendance*, 150.

January 14, 1925. — Waldo F. Pike in charge of the meeting. *General subject*, "Structural Steel." The subject was subdivided, with speakers and subjects as follows: F. S. Wells, of Densmore, LeClear & Robbins, "Design;" John C. Moses, of the Boston Bridge Works, "Fabrication;" W. H. Campbell, of the Boston Bridge Works, was scheduled to speak upon "Erection," but was unable to be present, and this subject was covered briefly by Mr. Moses; Frank F. Whitecross, of the Boston Building Department, spoke upon the "Boston Building Laws;" *attendance*, 108.

February 11, 1925. — Papers by members of the Section in competition for the prize offered by the main Society, as follows: "The Construction of the Neponset Bridge," by J. Stuart Crandall, Treasurer of the Crandall Engineering Company; "Structural Design Features of a Hydro-Electric Development," by W. D. Henderson, of Jackson & Moreland; "The Design of Supports for Superimposed Chimneys for Power Houses," by Walter W. Clifford, of Clifford & Roeblad; *attendance*, 100.

This is the first year that prizes have been awarded for papers presented by the Section.

Forty-eight new names have been added to the Section, and none have been dropped, making a net gain of 48. The membership now stands at 136.

The average attendance at the meetings was 83.

The Executive Committee suggests that either the November or the December meeting next fall be reserved for prize papers.

For the Executive Committee,

WALDO F. PIKE, *Clerk*.

Report of the Executive Committee of the Highway Section

BOSTON, February 25, 1925.

To the Highway Section of the Boston Society of Civil Engineers:

During the past year two meetings of the Highway Section have been held, as follows:

May 1, 1924. — Election of officers and adoption of By-Laws.

May 28, 1924. — A talk on Road Construction and Materials. Speakers, Mr. Samuel Hobbs of the Portland Cement Association; Mr. Prevost Hubbard of the Asphalt Association; and Mr. J. S. Crandell of the Barrett Company.

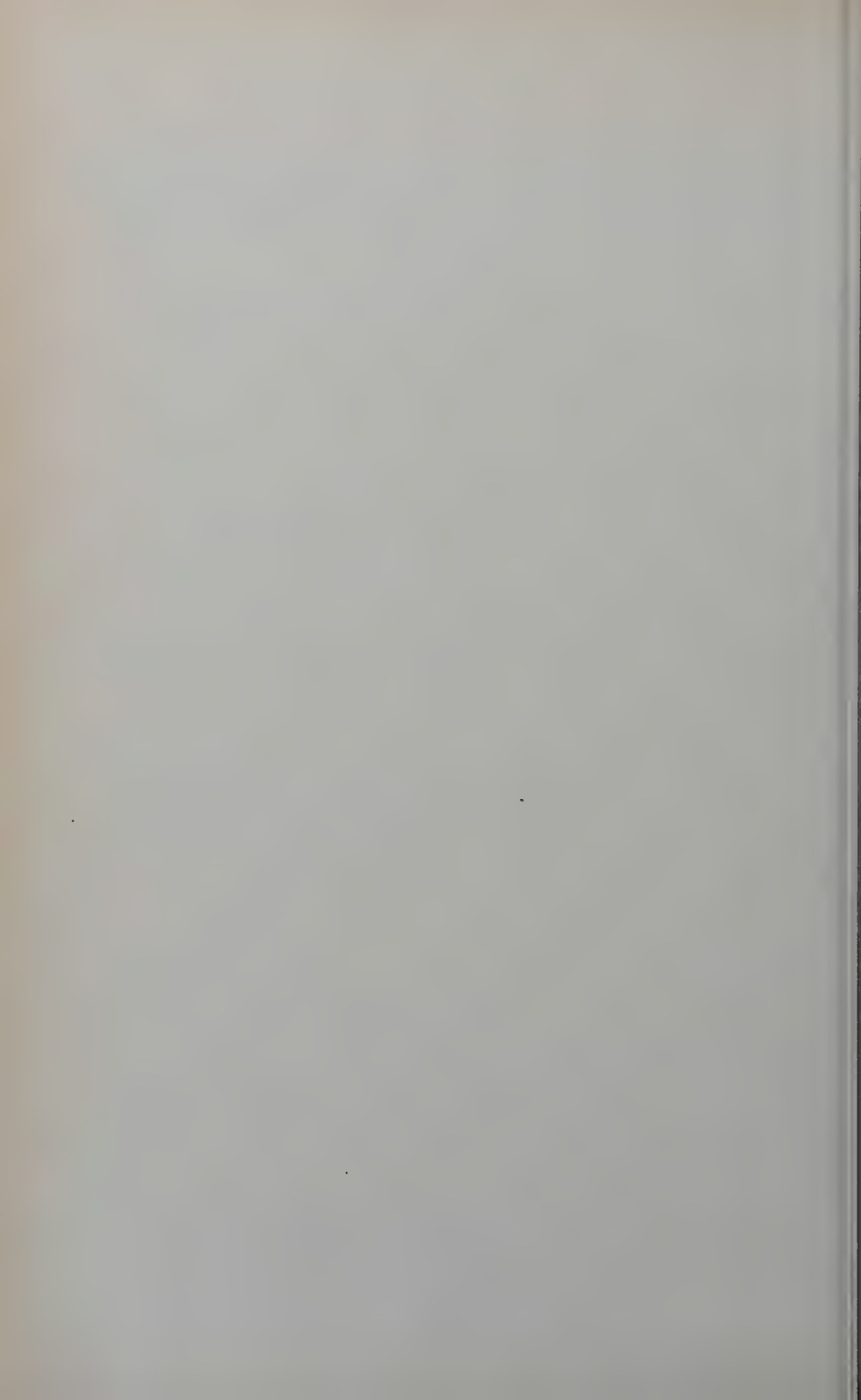
The executive committee had planned for an inspection trip to Lowell, Chelmsford and Tyngsborough on August 20, 1924, where three different kinds of construction were being done, but the work was finished before arrangements could be made.

Membership. — Original membership April 24, 1924, 36; additional members, 20. Total to date, 56.

Respectfully submitted,

For the Executive Committee,

A. B. APPLETON, *Clerk.*



BOSTON SOCIETY OF CIVIL ENGINEERS

FOUNDED 1848

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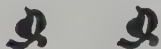
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